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xxv)	Performance of ryegrass ( <i>Lolium multiflorum</i> ) under integrated nutrient management	Richa Saikia
xxvi)	Effect of Plant Residue and Extract on Weed Management in Rabi Maize ( <i>Zea mays</i> )	Rimpa Das
xxvii)	Recent Techniques of Nitrogen Management in Wet Direct Seeded Sali Rice ( <i>Oryza sativa</i> L.)	Santanu Kaushik Borah
xxviii)	Response of hybrid maize ( <i>Zea mays</i> L.) to integrated nutrient management under different microclimatic regimes	Tapan Gogoi
xxix)	Effect of Integrated Nutrient Management Studies on Growth and Yield of Fodder Maize ( <i>Zea mays</i> L.)	Vijay Singh

#### **4.7. Crop Physiology**

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i)	Effects of Manganese on some rice genotypes in acid soil of Assam	Alankrita Dutta
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| ii)   | Effect of different storage conditions on grain quality of paddy ( <i>Oryza sativa</i> L.)                                                                      | Angshuman Sarmah    |
| iii)  | Physio-chemical responses of broccoli ( <i>Brassica oleracea</i> var. <i>italica</i> ) to different fertigation treatments                                      | Boishali Handique   |
| iv)   | Effect of Preharvest Application of Plant Growth Regulators on Morpho-Physiology, Yield and Vase Life of Gerbera ( <i>Gerbera jamesonii</i> )                   | Kuldeep Boruah      |
| v)    | Physiological performance of sweet sorghum ( <i>Sorghum bicolor</i> L. Moench) genotypes under Assam situation                                                  | Kundal Hazarika     |
| vi)   | Effects of Cytokinin and Calcium on Physiological Performance of Rice ( <i>Oryza sativa</i> L.) Crop under Higher Manganese Condition                           | Nibedita Basumatary |
| vii)  | Evaluation of Some Chickpea ( <i>Cicer arietinum</i> L.) Genotypes under Delayed Sowing Situation in Simulated Soil Moisture Condition                          | Priyanuj Baruah     |
| viii) | Nitrogen acquisition under elevated CO <sub>2</sub> and temperature in rice ( <i>Oryza sativa</i> L.)                                                           | Pronamee Doulboraah |
| ix)   | Physiological Basis of Drought Tolerance in Foxtail millet                                                                                                      | Ramesh R            |
| x)    | Effect of seed biopriming with indigenous fungal isolates on growth and yield of okra ( <i>Abelmoschus esculentus</i> L.)                                       | Rijuleena Bhuyan    |
| xi)   | Physiological Responses of Linseed ( <i>Linum usitatissimum</i> L.) to Different Organic Weed Management Practices                                              | Siddika Naznim      |
| xii)  | Physiological Responses of Locally Grown Foxtail Millet Genotypes [ <i>Setaria italica</i> (L.)] of North East Region to the Simulated High Temperature Regimes | Venkateshwaran R    |

#### 4.8. Entomology

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| i) Evaluation of Plant Oils against Papaya Mealybug, <i>Paracoccus marginatus</i> Williams and Granara de Willink                                                                          | Bondita Bora       |
| ii) Crop loss assessment and evaluation of certain insecticides against major insect pests of different okra cultivars                                                                     | Chada Anu Reddy    |
| iii) Biosynthesis and Evaluation of Ag-Nano Particle From <i>Polygonum hydropiper</i> against Storage Insect Pests                                                                         | Chandana C R       |
| iv) Interactions of cellular immunocytes in red pumpkin beetle, <i>Aulacophora foveicollis</i> (Coleoptera: Chrysomelidae) against entomopathogenic bacteria <i>Bacillus thuringiensis</i> | Diplina Yein       |
| v) Impact of certain newer insecticides on soil faunal diversity in French bean ( <i>Phaseolus vulgaris</i> L.)                                                                            | Gourismita Nath    |
| vi) Diversity of insect forager and effect of <i>Xylocopa fenestrata</i> pollination on sponge gourd ( <i>Luffa cylindrica</i> )                                                           | Irani Saikia       |
| vii) Evaluation of certain plant products and chemicals against banana leaf and fruit scarring beetle, <i>Nodostoma subcostatum</i> Jacoby (Coleoptera: Chrysomelidae)                     | Karanika Gogoi     |
| viii) Efficacy of certain newer insecticides against termite, <i>Odontotermes obesus</i> and red ant, <i>Dorylus orientalis</i>                                                            | Kasturi Sarmah     |
| ix) Population dynamics of mango fruit fly, <i>Bactrocera dorsalis</i> (Hendel) (Diptera:Tephritidae) and toxicity of certain insecticides against the pest                                | Manisha Urang      |
| x) Morphological and Biochemical bases of resistance of certain chilli germplasms against yellow mite, <i>Polyphagotarsonemus latus</i> (Banks)                                            | Nasreen Hussain    |
| xi) Evaluation of Cuelure against Fruit Fly, <i>Bactrocera cucurbitae</i> (Coquillett)                                                                                                     | Nishigandha Kakati |

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| xii)   | Effect of certain plant extracts against Tea looper; <i>Hyposidra talaca</i> Walker, Geometridae : Lepidoptera                               | Panchamika Dutta    |
| xiii)  | Bioformulation of entomopathogenic fungus against <i>Helopeltis theivora</i> Waterhouse (Hemiptera: Miridae)                                 | Priya Kaur          |
| xiv)   | Screening of rice varieties for resistance against <i>Sitophilus oryzae</i> (Coleoptera: Curculionidae)                                      | Priyanka Das        |
| xv)    | Population abundance of rice gundhi bug, <i>Leptocorisa</i> spp. and extent of damage caused by the pest in rice ecosystem                   | Priyanka Saikia     |
| xvi)   | Exploring the Therapeutic Properties of Honey of Stingless Bees, <i>Tetragonula iridipennis</i> (Smith)                                      | Puppala Sri Saranya |
| xvii)  | Efficacy of Certain Biopesticides for Management of Litchi Mite, <i>Aceria litchii</i> Keifer                                                | Ruby Hazowari       |
| xviii) | Insect-pest complex of sunflower, <i>Helianthus annuus</i> L. under different nitrogen management practices                                  | Rupam Das           |
| xix)   | Bioecology of Uzi Fly Infesting Mulberry Silkworm ( <i>Bombyx mori</i> L.)                                                                   | Rushali Chakraborty |
| xx)    | Compatibility of Two Native Entomopathogenic Fungi with Certain Botanicals and Their Efficacy against Termite, <i>Odontotermes obesus</i>    | Sanjay Hazarika     |
| xxi)   | Evaluation of AAU Jatropa oil formulation on white grub, <i>Lepidiota mansueta</i> Burmeister and termite, <i>Odontotermes obesus</i> Rambur | Shareen Tikhak      |
| xxii)  | Effect of Pollen Substitutes on Growth and Development of Honey Bee, <i>Apis cerana indica</i> F.                                            | Udeshna Borgohain   |

#### 4.9. Extension Education

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| i) | A study on knowledge and adoption of recommended plant protection formulations by small tea growers of North Bank Plains Zone of Assam | Bikkey Halder |
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| ii)   | Impact Assessment of Integrated Farming System Units of Kvk's Established under Rashtriya Krishi Vikas Yojana                                                | Chappidi Venkata Pujitha |
| iii)  | Effectiveness of Online Teaching-Learning among Agricultural Students during Covid-19 Pandemic: A Study on Students at Assam Agricultural University, Jorhat | Chaya Snigdha Deka       |
| iv)   | A study on the farmers' preference of High Yielding Varieties of rice released by Assam Agricultural University in Upper Brahmaputra Valley Zone of Assam    | Debangajyoti Borgohain   |
| v)    | A study on knowledge and adoption of organic farming practices of black rice (Chak-Hao) by the farmers of Manipur                                            | Kharibam Kabita Devi     |
| vi)   | Technological Empowerment of Flood Affected Farmers for Sustainable Rice Production in North Bank Plains Zone of Assam                                       | Manash Pratim Chetia     |
| vii)  | Farmers Preference Towards Farm Mechanization-A Study in North Bank Plain Zone of Assam                                                                      | Manjil Baruah            |
| viii) | Role awareness of extension functionaries in facilitating agricultural marketing in Assam                                                                    | Nipam Patowary           |
| ix)   | A study on utilization of livelihood diversification among small and marginal tribal farmers in North Bank Plains Zone of Assam                              | Prince Gogoi             |
| x)    | A Study on Effectiveness of Self-Help Groups (SHGS) Organized under Assam State Rural Livelihood Mission (ASRLM) in Jorhat District of Assam                 | Rittika Baruah           |
| xi)   | Agar ( <i>Aquilaria malaccensis</i> ) cultivation as a means of livelihood: A study in Golaghat and Sivasagar district of Assam                              | Simanku Pegu             |
| xii)  | A Study on the Organizational Culture and Employees' Mental Health Status of Assam Agricultural University, Jorhat                                           | Sugantha A P             |

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| xiii) | Impact Assessment of Assam State Rural Livelihoods Mission (ASRLM) in Providing Livelihood Security to Farm Women in Golaghat District of Assam | Susmita Phukan   |
| xiv)  | Adoption of Maize Based Cropping System in Flood Affected Areas as Coping Mechanism - A Study in Morigaon District, Assam                       | Swapnali Goswami |
| xv)   | Perception of Farmers on High Yielding Varieties of Rice Released by Assam Agricultural University- A Study in Golaghat District of Assam       | Varna Murali     |
| xvi)  | Evaluation of Capacity Building Programmes Organised by Sametiassam Vis-A-Vis Requirement of Extension Functionaries                            | Yerra Lahari     |

#### **4.10. Horticulture**

**482 – 556**

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| i)    | Supplementation of Nitrogenous Nutrient through organic sources in French Bean ( <i>Phaseolus vulgaris</i> L.)                                | Anupendra Narayan Deb |
| ii)   | Standardisation of stem cutting technique of Dragon Fruit ( <i>Hylocereus costaricensis</i> Britton & Rose)                                   | Anurag Borchetia      |
| iii)  | Integrated nutrient management in dolichos bean ( <i>Lablab purpureus</i> )                                                                   | Anshunam Tomar        |
| iv)   | Effect of time of planting and PCPA on off season production of Cherry Tomato [ <i>Solanum lycopersicum</i> (L) var. <i>cerasiforme</i> Mill] | Anusmita Neog         |
| v)    | Chemical and spectroscopic estimation of Kolakhar produced from parts of different Banana cultivars                                           | Aradhana Bordoloi     |
| vi)   | Organic Cultivation of Tuberose ( <i>Polianthes tuberosa</i> L.)                                                                              | Arishmita Gogoi       |
| vii)  | Response of Assam lemon ( <i>Citrus limon</i> L. Burm) to micronutrients                                                                      | Baishali Bhuyan       |
| viii) | Effect of Vine Management on Growth and Yield of Pumpkin ( <i>Cucurbita moschata</i> Poir.)                                                   | Barsha Nath           |

ix)	Influence of Planting Time and Spacing on Growth, Yield and Quality of Zucchini ( <i>Cucurbita pepo</i> L.) under Naturally Ventilated Polyhouse	Dhiraj Bhattacharjee
x)	Value addition of some underutilized fruits through osmodehydration	Dibyajyoti Saikia
xi)	Processing of Some Underutilized Fruits For Value Addition	Dikhasmita Bezbarua
xii)	Studies on Effect of Pre- Harvest Fruit Bagging on Yield and Quality of Litchi ( <i>Litchi chinensis</i> )	Diplip Barman
xiii)	Evaluation of some exotic varieties of tomato ( <i>Lycopersicon esculentum</i> Mill.) for North Bank Plain Zone of Assa	Harshantar Borsaikia
xvii)	Design and Development of Cold Plasma Generator for Food Application	Jaydev Barman
xviii)	Performance of some local cultivars of Pumpkin of Karbi Anglong in North Bank Plain Zone of Assam	Jnandeep Mudoï
xix)	Integrated nutrient management in lettuce ( <i>Lactuca sativa</i> L.)	Kangkana Nath
xx)	Performance of African marigold ( <i>Tagetes erecta</i> ) as influenced by organic inputs	Kamir Taropi
xxi)	Growth, yield and quality of Zucchini ( <i>Cucurbita pepo</i> ) as influenced by fertilizers and planting time	Masoom Mohanty
xxii)	Organic Amendments for Growth, Yield and Quality of Green Coriander ( <i>Coriandrum sativum</i> L.)	Mausum Kumar Nath
xxiii)	Effect of 3G Cutting on Growth, Yield and Quality of Watermelon ( <i>Citrullus lanatus</i> )	Murchana Deka
xxiv)	Performance of Palak ( <i>Beta vulgaris</i> var. <i>bengalensis</i> Hort.) as influenced by organic inputs, microbial consortium and packaging materials	Okenmang Jamoh
xxv)	Morphological and Quality Evaluation of elite litchi cultivars in Jorhat	Pansurika Saikia

xxvi)	Standardization of Planting Time and Spacing of Garland Chrysanthemum ( <i>Glebionis coronaria</i> (L.) Cass. ex Spach) in Assam	Plato Basumatary
xxvii)	Growth, flowering and corm production of gladiolus ( <i>Gladiolus grandiflorus</i> L.) as influenced by nitrogen and phosphorus	Polashi Kachari
xxviii)	Influence of planting dates and growing condition on yield and quality of Gladiolus ( <i>Gladiolus grandiflorus</i> L.) cv. Red Candyman	Prasanta Kumar Das
xxix)	Rapid Field Multiplication of Banana Using Different Treatments	Priyam Nandini Baruah
xxx)	Response of <i>Phaius tankervilleae</i> Bl. and <i>Spathoglottis plicata</i> Bl. to various nutrient concentration levels	Priyakshi Saikia
xxxii)	Intercropping in Assam Lemon ( <i>Citrus limon</i> )	Rasen Bey
xxxiii)	Integrated nutrient management in mango ( <i>Mangifera indica</i> L.) cv. Amrapali	Ritika Mehta
xxxiiii)	Standardization of planting time, planting methods and pinching techniques for summer season cut flower production of Zinnia elegans in Assam	Rubul Baruah
xxxv)	Growth Behaviour and Nutritional Profiling of Microgreens	Rumanchita Gogoi
xxxvi)	Effect of Different Treatments and Dates of Sowing on Seed Germination, Growth, Yield and Quality of Watermelon ( <i>Citrullus lanatus</i> ) in the North Bank Plain Zones of Assam	Sangeeta Mahajan
xxxvii)	Comparative performance of marigold hybrids ( <i>Tagetes erecta</i> L.) in different planting dates	Saptarisha Chetia
xxxviii)	Morphological evaluation of long pepper ( <i>Piper longum</i> ) germplasm	Srikanth P. N.
xxxix)	Effect of Nano-Dap on Growth Yield and Nutrient Use Efficiency in Cabbage	Suchibrata Chamuah



xxxix)	Development of Whey Fortified Low-Fat containing Muffins	Sumedha Agarwal
xl)	Performance of new banana ( <i>Musa</i> spp.) cultivars	Sunny Gogoi
xli)	Active Packaging For The Enhancement of Shelf Life In Strawberry ( <i>Fragaria</i> x <i>ananassa</i> Duch.)	Swarup Anand Dutta
xlii)	Organic Nutrient Management in Amaranthus	Swati Sulagna Sarangi

**4.10.1 Food Science & Technology (Horticulture) 482 – 556**

i)	Development of edible alkali (kolakhar) from Banana waste	Chemina Yesmin
ii)	Development of Value Added Products From Mushroom ( <i>Pleurotus ostreatus</i> )	Monjula Deka
iii)	Standardization of taro ( <i>Colocasia esculenta</i> ) based papads	Munni Das
iv)	Studies on development and evaluation of Dragon fruit ( <i>Hylocereus costaricensis</i> ) blended mixed fruit jam	Rajnandini Gogoi

**4.11. Nematology 557 – 563**

i)	Diversity and Abundance of Plant Parasitic Nematodes Associated with Vegetable Crops at Jorhat District of Assam	Arkadeb Chatterjee
ii)	Screening and Management of Root-knot Nematode, <i>Meloidogyne incognita</i> in Okra	Kangkan Patiri
iii)	Pathogenicity and Management of Reniform Nematode ( <i>Rotylenchulus reniformis</i> Linford & Oliveira, 1940) on Cowpea ( <i>Vigna unguiculata</i> )	Kshetrimayum Ria
iv)	Approaches for management of <i>Meloidogyne incognita</i> in Pulse crops	Maria Zonunpui
v)	A temporal assessment of nematode community structure in spice crops	Mitu Baishya

- vi) Grafting for the management of root knot nematode, *Meloidogyne incognita* in brinjal Polimera Prasanth

#### 4.12. Plant Breeding and Genetics

564 – 608

- i) Phenotypic Characterization of Photoperiod Insensitive Joha Rice Mutants under Post Flood Transplanted Situation Amarjeet Singh Bhogal
- ii) Performance of Some Rice (*Oryza sativa* L.) Genotypes in Direct Seeding and Transplanting for Grain Quality Characters Bidisha Bhattacharya
- iii) Hereditary Variation and Dna Fingerprinting in Cross Derivatives of Indica and Japonica Rice (*Oryza sativa* L.) Bijayalaxmi Maharana
- iv) Extent of Genetic Variation and Correlation Studies in Okra (*Abelmoschus esculentus* L. Moench) Biswajit Kaman
- v) Morphological Characterization of M4 and M5 Micromutants in Black Gram [*Vigna mungo* (L.) Hepper] Bonani Kakoty
- vi) Morpho-Chemical Evaluation and DNA Fingerprinting of Advanced Generation Lines of Pigmented Rice Chinmaya Bishoyi
- vii) Economic Analysis of Silk Weaving in Assam Dikprachurjya Bharali
- viii) Morpho-Molecular Characterization of Rajmah (*Phaseolus vulgaris* L.) Genotypes Dikshita Hazarika
- ix) Genetic variability analysis in F2 populations of indian mustard (*Brassica juncea*) (L.) Czern. & Coss.) Gracia Maisnam
- x) Heterosis and Combining Ability Analysis for Yield and Yield Attributing Traits in Sesame (*Sesamum indicum* L.) Jugal Chandra Talukdar
- xi) Studies on genetic variation and character association in brinjal (*Solanum melongena* L.) Kishore Medhi
- xii) Genetic variability studies on rice genotypes of Assam for ratooning ability and perenniality Neha Chakrawarti

xiii)	Evaluation of grass pea ( <i>Lathyrus sativus</i> L.) landraces for $\beta$ -ODAP content, fodder and grain yield	Niharika Dutta
xiv)	Characterization of soybean genotypes based on morphological and molecular markers	Niharika Saharia
xv)	Studies on Genetic Divergence in Oats ( <i>Avena sativa</i> L.)	Parameshwaran M
xvi)	Combining Ability for Yield and Yield Attributes in Indian Mustard [ <i>Brassica juncea</i> (L.) Czern & Coss]	Prastuti Bhattacharyya
xvii)	Morphological and molecular characterization of M5 mutant lines of indian mustard ( <i>Brassica juncea</i> (L) Czern. & Coss.) Cultivar NRCHB-101	Richa Bora
xviii)	Studies on genetic variation for pesticide induced chromosomal aberrations in onion ( L.)	Ritika Chakrabarty
xix)	Genetic Variability and Diversity Analysis in Potato ( <i>Solanum tuberosum</i> L.)	Shibani Ritusmita Borah
xx)	Studies of variability and divergence for seed and seedling traits of rapeseed and mustard	Sikha Barman
xxi)	Assessment of seed quality and incidence of aflatoxin in maize during storage	Sulakshana Baruah
xxii)	Evaluation of Joha Rice ( <i>Oryza sativa</i> L.) Mutants for Morpho-Agronomic Traits and their Photoperiodic Response	Tamma V.S.S. Manogna
xxiii)	Studies on Genetic Variability, Diversity and Characterization of <i>Curcuma caesia</i> Roxb. Germplasm of North-East India	Tasnim Zumaina Mazumder
xxiv)	Mutation Induction in Garden Pea ( <i>Pisum sativum</i> L.)	Thalari Vasanth Rao

#### 4.12.1. Plant Breeding and Genetics (SST)

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i)	Performance analysis of seed and seedling characteristics of rice and pigeon pea using nano particle mediated seed treatments	Jyotimoni Gogoi
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#### 4.13. Plant Pathology

609 – 645

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| i) Efficacy of green synthesized nanoparticles against Fusarium wilt of tomato                                                                                           | Amal Jyoti Debnath           |
| ii) Root endophytes from wild banana plant and their antagonistic potential against major pathogens of malbhog banana                                                    | Ankita Saikia                |
| iii) Efficacy of Double-Stranded RNA Inhibiting Transmission of Cucumber Mosaic Virus in King Chilli ( <i>Capsicum chinense</i> Jacq.)                                   | Anindita Saikia              |
| iv) Comparative Histopathological and Protein Profiling Approach to Study Tomato Resistance against <i>Ralstonia solanacearum</i>                                        | Bikoseeta Saikia             |
| v) Molecular detection and identification of soybean viral mosaic disease in Assam                                                                                       | Bishakha Deb                 |
| vi) Organic management of Pest and Diseases in Potato                                                                                                                    | Debarshi Patowary            |
| vii) Epidemiological Studies and Molecular Characterization of <i>Alternaria</i> spp. Infecting Cabbage in Assam                                                         | Jangila Hazowary             |
| viii) Identification, characterization and management of pumpkin mosaic disease                                                                                          | Kulumanali Gogoi             |
| ix) Taxonomic study on fungal flora associated with medicinal plants of Assam                                                                                            | Longkiri Rongpi              |
| x) Management of contamination of <i>Trichoderma</i> spp. in oyster mushroom bed with botanicals                                                                         | Mallikarjun Channappa Chitti |
| xi) Characterization of Microbial Load in Different Types of Made Tea                                                                                                    | Mirjeng Ronghang             |
| xii) Cultural, morphological and molecular variability among isolates of <i>Rhizoctonia solani</i> causing Web Blight of Green gram ( <i>Vigna radiata</i> (L.) Wilczek) | Mohana Pradeep R K           |

xiii)	Rhizospheric Microbes in Phytophthora Infected vs. Healthy Khasi Mandarin Plants ( <i>Citrus reticulata</i> Blanco.) and Evaluation of Native Bioagents	Mridupol Handique
xiv)	Compatibility Studies of Bio-Control Agents with Agrochemicals and Their Effect on Non-Target Insects of Vegetable Cropping System	Pooja Bharadwaz
xv)	Bio-Efficacy of Plant Growth Promoting Rhizobacteria against <i>Fusarium oxysporum</i> f.sp <i>lycopersici</i>	Lopamudra Giri
xvi)	Studies on biocidal activities of endophytes isolated from chilli against fruit rot pathogen of Bhut Jolokia ( <i>Capsicum chinense</i> Jacq.)	Partha Pratim Sarmah
xvii)	Microbe based management of citrus canker disease vis a vis prevailing weed flora	Pinkumoni Bokotial
xviii)	Integrated management of the viral disease complex in Bhut jolokia ( <i>Capsicum chinense</i> Jacq.)	Princy Khaidem
xix)	Incidence, Characterization and Integrated Management of Cucurbit Mosaic Disease	Puja Dey
xx)	Studies on occurrence and organic management of anthracnose of black pepper in nursery	Rajshree Verma
xxi)	Efficacy of Green Synthesized Zinc Oxide Nanoparticles (ZnO NPs) against Different <i>Fusarium</i> spp.	Rashmita Saikia
xxii)	Siderophores of fluorescent Pseudomonads and their role in suppression of bacterial wilt ( <i>Ralstonia solanacearum</i> ) of chilli	Sukanya Gogoi
xxiii)	Eco-friendly management of late blight, red ant and aphid in Potato	Swgwmsar Basumatary
xxiv)	Exploring the Effect of <i>Allamanda</i> Extract for yield Enhancement and Suppression of <i>Trichoderma</i> Contamination in Oyster Mushroom Beds	Tanushree Das

xxv)	Influence of sowing dates on incidence and severity of viral disease complex on soybean under field conditions	TC Lalruatfeli
<b>4.14. Sericulture</b>		<b>646 – 662</b>
i)	Study on effect of methionine and tryptophan on the larval growth, cocoon characters and reproductive parameters of eri silkworm, <i>Samia ricini</i> Donovan	Abhyarthana Hazarika
ii)	A study on the extent of adoption of scientific muga culture technology by the rearers of Sonitpur district of Assam	Dababrata Saikia
iii)	Study on defoliators and their natural enemies in mulberry ecosystem	Deeplina Bora
iv)	Tapioca ( <i>Manihot esculanta</i> ) cultivation as an alternate farm plan for rearing eri silkworm in Udalguri district of Assam	Jugabrat Sarma
v)	Studies on incidence and population build up of Amphutukoni muga ( <i>Cricula trifenestrata</i> Helfer) on Som ( <i>Persea bombycina</i> King.) plant	Parashpriya Borah
vi)	Studies on Epidemiology and Management of Cercospora Leaf Spot of Castor ( <i>Ricinus communis</i> L.) in Agro-climatic Condition of Assam	Prety Rekha Narzary
vii)	Studies on the production, processing and marketing of sericulture in Dima Hasao district of Assam	Rastra Nunisa
viii)	A Study on the Training Need Assessment of Silkworm Rearers in Golaghat District of Assam	Sewali Gogoi
ix)	Influence of fertilizer management practices on point of zero charge (PZC) in soils of Assam and Odisha	Subhra Parija
<b>4.15. Soil Science</b>		<b>663 – 698</b>
i)	Assessment of sediment yield and water quality of Bhogdoi river basin using remote sensing and GIS techniques	Abinash Mazumder

ii)	Assessment of Soil Zinc Fractions and their Relationship with Physico-Chemical Properties of Rice Growing Soils of Boko Block of Kamrup (rural) District, Assam	Abreeta Kalita
iii)	Nutrient Release Pattern of Organic Manures in An Acidic Inceptisol of Assam	Ankita Nath
iv)	Geospatial Assessment of Soil Erodibility and Land Irrigability in a Transect of Simen River Basin of Assam	Baishaali Sarma
v)	Soil fertility status in relation to fallow cycle in shifting cultivated areas of Dima Hasao	Baosring Nunisa
vi)	Characterization of Plant Growth Promoting Rhizobacteria (PGPR) from Rhizosphere Microbiome of <i>Tezpur Litchi</i> Growing Areas of Assam	Bonjuri Saikia
vii)	Assessment of Chemical Properties of Litchi Growing Soils of Assam	Chittadeep Nath
viii)	Distribution of Arsenic in Rice Soils of Titabar, Jorhat	Denim Bora
ix)	Hydrophysical properties and erodibility of Brahmaputra river bank soils under Golaghat district	Dipsikha Goswami
x)	Assessment of earthworm cast quality in different land uses of Assam	Mousumi Dutta
xi)	Implications of Aluminium and Fluoride in Plucked Tea Leaves and Soils of Doomdooma Area in Assam	Namrata Rajbonshi
xii)	Soil Boron fractions as influenced by selected soil properties and cropping system in Boko block of Kamrup (Rural) district of Assam	Neelom Baruah
xiii)	Bioresource potential of filamentous cyanobacteria from paddy fields of Assam and its evaluation	Nikita Laishram
xiv)	Influence of biochar on soil physico-chemical properties	Priyambi Saikia

xv)	Bioconversion of municipal solid waste into fortified compost using microbial mediators	Rimjim Sikha Bora
xvi)	Synthesis, characterization and release of nano-enabled phosphorus fertilizer in acid soils of Assam	Sukanya Pachani
xvii)	Screening of Bio-Resource For Preparation of Quality Organics	Sukhvindar
xviii)	Effect of P-Enriched Biochar on Properties of Acid Soil	Varanasi Surya Teja

#### **4.16. Tea Husbandry & Technology**

**699 – 704**

i)	Studies on non-chemical methods for management of tea pests and use of plant based formulations against red spider mite	Bidisha Hazarika
ii)	Morpho-physiological and biochemical characterization of tea [ <i>Camellia sinensis</i> (L) O. Kuntze] germplasm maintained in the field gene bank of AAU	Bidisha Narah
iii)	Studies on non-chemical methods for management of tea pests and use of oil based formulations against red spider mite	Joyshree Konwar

### **5. Master of Science (Fishery)**

#### **5.1. Aquaculture**

**706 – 713**

i)	Effect of Diet on Growth, Haematology and Disease Resistance of Amur Carp ( <i>Cyprinus carpio haematopterus</i> ) Through Replacement of Rice Polish With Rice Beer Waste	Astrica Phukan
ii)	Effect of stocking densities on growth performance and survivability of Amur Carp ( <i>Cyprinus carpiohaematopterus</i> ) in floating cage environment of a floodplain wetland of Morigaon District	Homen Saikia
iii)	Experimental Breeding Ofchanna Striatus (Bloch, 1793) Using Different Hormones under the Agro-Climatic Condition of Assam	Rikki Bagra



iv) Effect of probiotic bacteria identified and characterized from gut of freshwater fish on growth performance of <i>Labeo rohita</i>	Rubina Yasmin
v) Evaluation of Some Non-Conventional Animal Protein Sources in the Practical Diet Formulation of Fresh Water Cat Fish <i>Clarias magur</i> and Its Effect on Growth and Biochemical Composition	Shah Mustahid Hussain
<b>5.2. Aquatic Environment Management</b>	<b>714 – 721</b>
i) Study of Productivity and Ichthyofaunal Diversity of Kharungpat Lake, Manipur	Abdul Salam
ii) Acute Toxicity Study of Silica Nanoparticles (SiO <sub>2</sub> -NPs) on <i>Cyprinus carpio</i> (Linnaeus, 1758)	Habiba Jahan Ahmed
iii) <i>In Vivo</i> Evaluation of Toxicity effects of a Neonicotinoid Insecticide Imidacloprid on Freshwater Cypriniform <i>Cyprinus carpio</i> var. <i>communis</i>	Hemanta Pokhrel
iv) Effect of pH on Acute Toxicity of Synthetic Antioxidant Butylated Hydroxytoluene in Embryo of Zebrafish <i>Danio rerio</i> (Hamilton, 1822)	Nikimoni Borah
v) Assessment of Acute Toxicity in Fresh Water Cypriniform <i>Cyprinus carpio</i> (Linnaeus, 1758) Exposed to a Commercial Neem based Biopesticide	Rituparna Borah
vi) Acute Toxicity of Synthetic Pyrethroid Pesticide Cypermethrin in Developing Zebrafish ( <i>Danio rerio</i> ) (Hamilton-Buchanan, 1822) Embryo	Ruhul Amin
<b>5.3. Fish Processing Technology</b>	<b>722 – 724</b>
i) Effect of Garlic Extract on Quality of Dried <i>Puntius sophore</i> During Storage at Ambient Temperature	Ipsita Jamatia
ii) Effect of Ginger Extract on Quality of Dried <i>Amblypharyngodon mola</i> During Storage at Ambient Temperature	Misan Debbarma
<b>5.4. Fisheries Resource Management</b>	<b>725 – 728</b>
i) Study on Ichthyofaunal Diversity and Physicochemical Parameters Downstream of Hydroelectric Power Project Dam of Subansiri River, Assam	Imran Hussain

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|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| ii) Study on Ichthyofaunal Diversity and Physico-Chemical Parameters of a Floodplain Wetland (Jaluguti <i>Beel</i> , Morigaon District, Assam) of Central Brahmaputra Valley Zone | Sheetala Chintey |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|

**6. Master of Science (Home Science)**

**6.1. Extension and Communication Management 730 – 743**

- |                                                                                                                                               |                       |
|-----------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| i) Knowledge and practice of adolescent girls of Jorhat district of Assam on personal hygiene with special reference to menstrual hygiene     | Anwasha Bijoy Chetia  |
| ii) Knowledge and practice of farmers in production of mushroom for livelihood security                                                       | Debasish Saikia       |
| iii) Aspiration of Rural Youth towards Agriculture as an Enterprise for Livelihood Security                                                   | Gayatri Gogoi         |
| iv) Impact of Farmers’ Fair on Technology Adoption                                                                                            | Kabyashree Bora       |
| v) Digital Literacy Among Rural People of Assam                                                                                               | Munmi Boruah          |
| vi) Financial Literacy Among Young Employees: A Study in Assam Agricultural University, Jorhat                                                | Poonam                |
| vii) Public-Private Partnership for Marketing Management of Selected Woven Products for Weavers of Assam for Sustainable Economic Development | Sangeeta Borah Saikia |

**6.2. Family Resource Management 744 – 753**

- |                                                                                             |                  |
|---------------------------------------------------------------------------------------------|------------------|
| i) Workspace environment of the Computer operating Employees in Banking Sector- An Analysis | Animesh Gogoi    |
| ii) Study of consumer awareness and buying practices towards green products                 | Askino R. Marak  |
| iii) Assessment of Environmental Parameters in Domestic Kitchen of Jorhat Sub-Division      | Kimbai A. Sangma |
| iv) Assessment of Occupational Health Hazards of Office Employees                           | Malobika Gogoi   |

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|------|------------------------------------------------------------------------------------------------------------------------------|--------------------|
| v)   | Packaging and Consumer Buying Behaviour                                                                                      | Mriganka Sonowal   |
| vi)  | Utilization of institutional microfinance by beneficiaries – A study in Sivasagar district of Assam                          | Parthapratim Gogoi |
| vii) | Prevalence of ergonomics risk factors and work related health problems at work: Special reference to filigree work of Odisha | Sarmistha Mishra   |

### **6.3. Food Science and Nutrition**

**754 – 769**

- |       |                                                                                                                    |                       |
|-------|--------------------------------------------------------------------------------------------------------------------|-----------------------|
| i)    | Hypocholesterolemic and hypoglycemic effects of multi-strain probiotic beverage                                    | Deeptimayee Mahapatra |
| ii)   | Development of micronutrient rich supplements from locally available foods                                         | Ishita Nath           |
| iii)  | Development and quality evaluation of hydrothermally treated rice from Kaoi Jamfri – a red kernel rice of Assam    | Mandeep Digra         |
| iv)   | Effect of processing on antioxidant potential and antidiabetic activity of <i>Cajanus cajan</i> (L.) tender leaves | Meghna Borgohain      |
| v)    | Development of value added cookies incorporating <i>Perilla frutescens</i> seeds                                   | Oinam Latasha Devi    |
| vi)   | Development of gluten- free functional rice bread                                                                  | Pallabi Sarkar        |
| viii) | Assessment of nutritional status of Karbi adolescent girls from Diphu, Assam                                       | Puspa Khakhlary       |
| ix)   | Development and quality evaluation of nutri-dense pancake mix                                                      | Taposhi Thakuria      |

### **6.4. Human Development and Family Studies**

**770 – 772**

- |     |                                                                                                   |                      |
|-----|---------------------------------------------------------------------------------------------------|----------------------|
| i)  | Impact of Reading Habits on the Academic Performance of Adolescents in Golaghat district of Assam | Arundhati Khound     |
| ii) | Students' perception towards online school                                                        | Merina Machiya Deori |

## 6.5. Textiles and Apparel Designing

773 – 791

- |                                                                                                                                                    |                         |
|----------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| i) Documentation and adaptation of motifs of Madhubani painting of Bihar to develop diversified products using hand printing techniques            | Anima Mandal            |
| ii) Designing Transformable Apparel For Women: A Sustainable Solution to Overconsumption of Clothing                                               | Anjali Kaman            |
| iii) Evaluation of Ultra-Violet Protection Property of Cotton Fabric Dyed with Leaves of <i>Coffea Arabica</i> – A Natural Colourant               | Banashree Handique      |
| iv) Enzymatic extraction and processing of non-conventional fiber from betel nut ( <i>Areca catechu</i> )                                          | Debangana Priya Bora    |
| v) Resurgence of Traditional Assamese Motifs: Their Application in Contemporary Indian Women’s Wear                                                | Dristirupa Nath         |
| vi) A study on the Costumes of Meghalaya with special preference to Jaintia tribe                                                                  | Hosanna Sumer           |
| vii) An Empirical Study on Profile of Handlooms of Jorhat District of Assam                                                                        | Milan Saikia            |
| viii) Study the effect of natural mordants on eco-friendly dyeing of eri matka silk of Manipur with bark of mango ( <i>Mangifera indica</i> ) tree | Ngangbam Vedamani Chanu |
| ix) Ecofriendly Utilization of Eucalyptus Bark Extract for Dyeing of Silk with Natural Mordant                                                     | Pinki Gogoi             |
| x) Development of Color Palette Using “ <i>Rubia cordifolia</i> ” Dye for Creating Sustainable Fashion From Eri Silk                               | Rubi Pranjana Tamuli    |
| xi) Development of Mulberry Silk Union Textiles for Sustainable Fashion                                                                            | Shradhasmita Dutta      |
| xii) Optimization of Extraction and Dyeing Parameters of Lac dye from <i>Kerria chinensis</i> (Mahd.) on cotton                                    | Sourav Baruah           |
| xiii) Extraction of fibre from <i>Ricinus communis</i> and evaluation of its physical and chemical properties                                      | Trideep Bor Saikia      |

## 7. Master of Science (Veterinary Science)

<b>7.1. Animal Biotechnology</b>	<b>793 – 798</b>
i) Evaluation of PagN-Based Peptide(S) in Combination with Vi-Capsular Antigen as Vaccine Candidate for <i>Salmonella</i> Typhi	Puranpurna Goswami
ii) DNA Polymorphism in Mitochondrial Genes Encoding ND1, CO1 and CYTB in Canine Malignant Tumours	Shakeel-Ul-Rehman
iii) Molecular Characterization of Lactobacilli isolated from Indigenous Ducks of Assam and <i>in vitro</i> Assessment of their Probiotic Activity	Samiso Kramsapi
<b>7.2. Animal Genetics and Breeding</b>	<b>799 – 800</b>
i) Performance of Indigenous Chicken in Certain Districts of Assam Under Backyard Farming System	Jehirul Islam
<b>7.3. Animal Nutrition</b>	<b>801 – 813</b>
i) Effects of Feeding of Prebiotics, Probiotics and Synbiotics in Broiler Chicken on Corn-Soya Based Diet	Aibaniairi Fancon
ii) Effect of Black Pepper ( <i>Piper nigrum</i> ) Supplementation to Diets Containing Different Levels of Energy on the Growth Performance, Nutrient Utilization and Blood Biochemical Profile of Growing Pigs	Akash Mahanta
iii) Effect of Feeding Dry <i>Moringa oleifera</i> Leaves on Growth Performance and Nutrient Utilization in Crossbred Calves	Anisul Hamza
iv) Performance of Broiler Chicken Fed on Diet Supplemented with Oregano Essential Oil	Biswajit Borah
v) Effect of Feeding Nano-Iron on Growth Performance and Nutrient Utilization in Grower Pigs	Dangshawa Morung

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|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| vi)   | Effect of Feeding Azolla ( <i>Azolla pinnata</i> ) Based Complete Feed Block on Growth, Nutrients Utilization and Blood Biochemical Parameters of Beetal X Assam Hill Goats | Mostafizur Ahmed |
| vii)  | Effect of Supplementation of Acidifier on the Performance of Broiler Chicken                                                                                                | Rupjyoti Dutta   |
| viii) | Effect of Feeding Varying Levels of Subabul ( <i>Leucaena leucocephala</i> ) Leaf Meal on The Performance of Broiler Chicken                                                | Tanmoy Medhi     |

#### **7.4. Animal Reproduction, Gynaecology and Obstetrics**

**814 – 831**

- |       |                                                                                                                                 |                           |
|-------|---------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| i)    | Effect of Bypass Fat and Bypass Protein Supplementation During Transition Period on Reproductive Performance of Assam Hill Goat | Akshay Krishnamurti Hegde |
| ii)   | Reproductive Performance in Prepubertal Assam Hill Goat Supplemented with Bypass Fat                                            | Arjyarittik Kalita        |
| iii)  | Extrapolation of Gestational Curve and Whelping Time in Bitch                                                                   | Chayanika Das             |
| iv)   | Effect of Nano Zinc Supplementation on Reproductive Performance of Assam Hill Goat                                              | Dipika Deori Abstract     |
| v)    | Diagnostic and Therapeutic Management of Canine Transmissible Venereal Tumour (CTVT)                                            | H. Phunchu Bappo          |
| vi)   | Pregnancy Diagnosis in Pig with Special Reference to Biomarker Analysis                                                         | Jyotimalita Roy           |
| vii)  | Correlation of Insulin Like Growth Factor-1 Concentration with Semen Characteristics of Beetal Buck                             | Keshav                    |
| viii) | Nanoemulsions for Reducing Oxidative Stress in Cryopreserved Buck Semen                                                         | Soihem Diana Rongmei      |
| ix)   | Performance of Hampshire Piglets Reared on Hot Water Treated Floor                                                              | Sweta Pachani             |

<b>7.5. Veterinary Anatomy and Histology</b>	<b>832 – 833</b>
i) Anatomical Studies on Liver and Pancreas of <i>Pati</i> Ducks ( <i>Anas platyrhynchos domesticus</i> ) of Assam During Post-Natal Development	Kulajit Kalita
<b>7.6. Veterinary Clinical Medicine, Ethics &amp; Jurisprudence</b>	<b>834 – 846</b>
i) Sub Clinical Mastitis in Buffalo and Its Therapeutic Management	Chainmoy Sarma
ii) Anthelmintic Activity of <i>Acorus calamus</i> Rhizome Extract Against <i>Haemonchus</i> Species in Goats	Champa Sharma
iii) Sub-Clinical Mastitis in Dairy Cow and Its Therapeutic Management	Gaurab Kafle
iv) Osteomalacia : Its Diagnosis and Management in Dairy Cows	Gunajit Barman
v) Studies on Anthelmintic Efficacy of <i>Zanthoxylum armatum</i> Against Gastrointestinal Parasites of Goat	Jakir Hussain
vi) L Inico-Haematobiochemical and Therapeutic Management of Anaemia Associated with Chronic Kidney Disease (CKD) in Dog	Pradyout Pallav Hazarika
vii) Congestive Heart Failure in Dogs and Its Therapeutic Management	Prerona Patowary
viii) Evaluation of Salivary Biomarkers for Chronic Kidney Disease in Dogs	Tanu Sharma
ix) Transmission of Newcastle Disease Virus at Domestic-Wild Bird Interface	Abhilasha Sharma
<b>7.7. Veterinary Epidemiology and Preventive Medicine</b>	<b>847 – 861</b>
i) Management of Clostridial Infection with Special Reference to <i>Clostridium perfringens</i> in Asiatic Elephant ( <i>Elephas maximus</i> ) in Assam	Ashit Chakraborty

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|---------------------------------------------------------------------------------------------------------------------------------------|----------------------------|
| ii) Epidemiology and Economic Impact of Rabies in Animals of Kamrup Metro District of Assam and West District of Tripura              | Bishal Debbarma            |
| iii) Detection and Genotypic Characterization of Rotavirus in Dog and Its Management                                                  | Chayanika Mazumder         |
| iv) Epidemiological Study and Economic Impact of African Swine Fever in Few Affected Districts of Assam                               | Jahnabi Doley              |
| v) Parvoviral Enteritis in Puppies and Its Therapeutic Management                                                                     | Sayed Nazrin Rumana Rahman |
| vi) Evaluation of Immune Response in Broiler Chicks Immunized with a Minimum Cold Chain Dependent Newcastle Disease Virus Formulation | Rofique Ahmed              |
| vii) Prevalence of Bat Lyssavirus in Assam                                                                                            | Tinku Das                  |
| viii) Ehrlichiosis In Dogs: Its Epidemiology And Therapeutic Management                                                               | Queen Devi                 |

#### **7.8. Veterinary Extension Education**

**862 – 873**

- |                                                                                                                                                                                                     |                        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| i) Adoption Level in Scientific Poultry Rearing Practices in Ri-Bhoi District of Meghalaya                                                                                                          | David Teileng Sun      |
| ii) Impact of Female Participation in Livestock and Poultry Enterprises in Ensuring Women Empowerment and Household Food Security Among Selected Tribes/ Ethnic Group in Goalpara District of Assam | Deepjyoti Roy          |
| iii) Participation of Tribal Farmwomen in Livestock Management Activities in Dima Hasao District of Assam                                                                                           | Komolika Bodo          |
| iv) Dynamics of Urbanization in the Livelihood of Livestock Farmers in the Peri-Urban Areas of Guwahati City                                                                                        | Parag Sankar Choudhury |
| v) Women Empowerment Through Self-Help Group With Special Reference to Animal Husbandry: ASRLM Perspective                                                                                          | Rahul Kanti Deka       |



<b>7.9. Veterinary Livestock Production and Management</b>	<b>874 – 895</b>
i) Performance of Assam Hill Goat Reared Under Bamboo and Wooden House	Armina Sultana Begum
ii) Effect of Floor Types on the Milk Quality and Health Status of Crossbred Cows Under Field Condition	Arup Deka
iii) Effect of Dietary Supplementation of Yeast ( <i>Saccharomyces cerevisiae</i> ) on Growth Performance of Crossbred Heifers	Chandrika Hazarika
iv) Productive Performance of Sahiwal Cows Subjected to Different Levels of Herbal Supplements	Manmi Kalita
v) Performance of Hampshire Piglets Reared on Hot Water Treated Floor	Phanidhar Mili
vi) Growth Performance of Crossbred Calves Fed Molasses and Probiotics Supplemented Diet	Sanidur Ahmed
vii) Performance of Assam Hill Goat Reared on Periodically Disinfected Floor	Santana Das
viii) Study on The Indigenous Knowledge System on Pig Rearing Adopted by The Rabha Community of Assam	Sayashree Rabha
ix) Shelf Life of Raw Cow Milk in Different Temperatures	Subarna Sarkar
x) Effect of Supplementing Garlic Powder on The Performance of The Sahiwal Calves	Zara Kaku Sorang
<b>7.10. Veterinary Livestock Products Technology</b>	<b>896 – 901</b>
i) Quality Characteristics of Soy Milk Blended Yoghurt	Arifa Khatun
ii) Development of Duck Meat Sausages Incorporated with Foxtail Millet ( <i>Setaria italica</i> )	Kiran Moye Handique
iii) Development of Enzyme Based Chromogenic Strips for Detection of Selected Adulterants in Milk	Priya Muktan

<b>7.11. Veterinary Microbiology</b>	<b>902 – 912</b>
i) Seroprevalence and Molecular Detection of Bovine Brucellosis and Leptospirosis in Assam	Bandana Devi
ii) Neutralization Efficacy of Classical Swine Fever C-Strain Specific Antibody to Different Genotypes Circulating in North Eastern States, India	Jayashree Sarma
iii) Physicochemical properties of live attenuated duck plague vaccine and evaluation of stabilizer efficacy for lyophilization	Jonmoni Barua
iv) Adaptation of Mesogenic Newcastle Disease Virus (Genotype XIII) in Vero Cell And Its Immunogenic Potential	Lewamangphika Raptap
v) Seroprevalence and Molecular Characterization of Porcine Circovirus 2 (PCV2) in Certain Districts of Assam	Sabnam Ingtipi
vi) Molecular Characterization of Avipoxvirus From Domestic Ducks	Sumi Chungkrang
<b>7.12. Veterinary Parasitology</b>	<b>913 – 916</b>
i) Ectoparasites of Goat With Special Reference to Mange Mite	Debjani Borah
ii) Forensic entomology-based post-mortem interval estimation in animals and birds	Souvik Sarma
<b>7.13. Veterinary Pathology</b>	<b>917 – 933</b>
i) Pathomorphological and Molecular Studies of Respiratory Mannheimiosis in Goats	Amdedul Islam Mazumder
ii) Prevalence and Pathology of Duck Pasteurellosis and Its Concurrent Infection with Duck Virus Enteritis	Anjali Das
iii) Etiopathological Studies on Bacterial Pneumonia In Goats	Deepjyoti Saharia

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|-------|-------------------------------------------------------------------------------------------------------|-------------------------|
| iv)   | Pathomorphological and Molecular Detection of Avian Leukosis Virus Infection in Chicken               | Nibedita Tamuly         |
| v)    | Pathomorphology and Molecular Detection of Mycoplasma infection in Broiler Chicken                    | Risabh Sarmah           |
| vii)  | Clinicopathological Study of Anemia with Special Reference to Canine Babesiosis                       | Ruby Devi Nath          |
| viii) | Pathomorphological and Molecular Detection of Bacterial Pathogens Associated with Porcine Pneumonia   | Sabina Yasmin           |
| ix)   | Etiopathology of pre-weaning mortality in Piglets with particular Emphasis on Anemia and Hypoglycemia | Samiran Borah           |
| x)    | Pathomorphological and Molecular Detection of <i>Riemerella anatipestifer</i> Infection in Duck       | Udaya Sai Sitaram Tella |

**7.14. Veterinary Pharmacology and Toxicology** **934 – 936**

- |    |                                                                                                                     |                 |
|----|---------------------------------------------------------------------------------------------------------------------|-----------------|
| i) | Evaluation of Anti-Inflammatory, Analgesic and Antipyretic Activity of <i>Nyctanthes arbor-tristis</i> Leaf Extract | Sumitra Debnath |
|----|---------------------------------------------------------------------------------------------------------------------|-----------------|

**7.15. Veterinary Physiology** **937 - 944**

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|------|---------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| i)   | Monitoring Certain Physiobiochemical Parameters of Post Weaned Crossbred Kids Raised under Three Different Climate Resilient Housing System | Dhiman Patgiri |
| ii)  | Physiological Effect of Cryoprotectants in Freezing of Embryonic Fibroblast Cells                                                           | Faijun Toufiki |
| iii) | Strategy for Development of Stem Cell Like Embryonic Fibroblast Cells                                                                       | Prerana Das    |
| iv)  | Monitoring Physio-Biochemical Characteristics in Goat During Transition Period Following Selenium and Vitamin E Supplementation             | Salima Siddika |

<b>7.16. Veterinary Poultry Science</b>	<b>945 - 961</b>
i) Analysis of Duck Farming Systems in Morigaon District of Assam	Anuj Dutta
ii) Utilization of Chicken Whole Blood for Preparation of Chicken Nuggets	Konmoni Goyari
ii) Effect of Dietary Supplementation of Aloe Vera ( <i>Aloe barbadensis</i> M.) Leaves Powder on the Performance and Carcass Quality of Commercial Broiler Chickens	Manasjyoti Thakuria
iii) Effect of Dietary Supplementation of Marigold Flower Powder on The Productive Performance of Broiler Chickens	Rajsekhar Sapkota
iv) Quality Evaluation and Shelf Life Study of Chicken Meat Patty Incorporated with Chicken Blood Plasma and Mint Powder	Shakura Siddika Barbhuiya
v) Effect of Dietary Supplementation of Curry Leaves ( <i>Murraya koenigii</i> ) Powder on The Performance and Histology of Certain Lymphoid Organs of Commercial Broiler Chicken	Sukanya Deori
<b>7.17. Veterinary Public Health</b>	<b>962 – 965</b>
i) Sero-Prevalence and Molecular Detection of Canine Brucellosis in Urban and Peri-Urban Areas of Guwahati	Malela Saikrishna Goud
ii) Sero-Prevalence and Molecular Detection of Leptospire in Dogs of Peri-Urban Livestock Farms and Urban Households of Guwahati	Ritriha Saikia
<b>7.18. Veterinary Surgery and Radiology</b>	<b>966 – 986</b>
i) Comparative Evaluation of Interlocking Nailing and Locking Compression Plating Vis-À-Vis Management of Long Bone Fractures in Canine	Anjali C J
ii) Evaluation of Xenogenic Acellular Pericardium Matrix of Caprine and Porcine Origin for Abdominal Wall Reconstruction in Rabbit	Anjali Padhan

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|-------|------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| iii)  | Effect of Jackfruit ( <i>Artocarpus heterophyllus</i> ) Sap and Chitosan Derived Biosealant on Wound Management                                | Banashree Gogoi    |
| iv)   | Ultrasound Guided Epidural Analgesia for Perioperative Pain Management in Dogs Undergoing Ovariohysterectomy Operation                         | Bindiya Mahanta    |
| v)    | The Efficacy of Pectin-Honey Hydrogel and Olive Oil-Vitamin E Preparation in Prevention of Post-Operative Intraperitoneal Adhesions in Rabbits | Fulmoni Kalita     |
| vi)   | Effects of Certain Anaesthetic Combinations in Goat                                                                                            | Gyandeep Choudhury |
| vii)  | Investigation of Ocular Maladies and Their Therapeutic Management in Veterinary Patients                                                       | Iftikar Islam      |
| viii) | Comparative Study of Surgical Affections of Lakhimi and Cross-Bred Cattle of Assam With their Therapeutic Management                           | Milton Engti       |
| ix)   | Dental Affections and Their Management in Dogs                                                                                                 | Pinku Talukdar     |
| x)    | Diagnosis, Treatment and Rehabilitation of Coxofemoral Joint Affections in Dogs                                                                | Pracheer Budhwar   |
| xi)   | Diagnosis of Canine Heart Diseases with Special Reference to Transthoracic Echocardiography                                                    | Rimjhim Das        |
| xii)  | Diagnosis and Treatment of Alimentary Tract Disorders in Dogs with Special Reference to Surgical Affections                                    | Ritu Raj Saikia    |
| xiii) | Diagnosis and Treatment of Spinal Affections in Dogs and Cats                                                                                  | Shantishree Das    |

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## **Ph.D (Agriculture)**

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- **Agricultural Biochemistry**
- **Agricultural Biotechnology**
- **Agricultural Economics and Farm Management**
  - **Agronomy**
  - **Crop Physiology**
    - **Entomology**
  - **Extension Education**
    - **Horticulture**
    - **Nematology**
- **Plant Breeding and Genetics**
  - **Plant Pathology**
    - **Sericulture**
    - **Soil Science**
- **Tea Husbandry and Technology**

## **Nutritional evaluation of few grass pea (*Lathyrus sativus* L.) genotypes of Assam**

*Bandana Choudhury*

Grass pea or chickling pea (*Lathyrus sativus* L.), also known as Khesari dal in India, is a low-cost source of protein in underdeveloped nations. Grass pea is a potential crop as it is tolerant to drought, water-logging, and salinity. Despite these virtues, the worldwide area of cultivation has declined in recent years due to prohibition on its cultivation. The ban is imposed due to the presence of an antinutrient that acts as a neurotoxin  $\beta$ -N-oxalyl- $\alpha$ ,  $\beta$ -diamino-propionic acid ( $\beta$ -ODAP), also known as  $\beta$ -N-oxalyl amino alanine (BOAA). In Assam and North East India, a great range of grass pea genotypes are widely farmed. The purpose of this study is to examine the proximate composition, antioxidant and anti-nutritional properties of a few grass pea genotypes of Assam. In the present investigation, nine grass pea genotypes were collected from Regional Agricultural Research Station, Shillongani and two genotypes were obtained from the farmer's land, Bongaigaon. Grass pea genotypes were found varying significantly in their proximate composition with moisture content ranging from 8.46 to 10.39% (on fresh weight basis), crude protein: 26.24 – 29.70%, crude fat: 1.19 – 2.34%, total carbohydrate: 50.85 – 55.34%, crude fibre: 6.57 – 8.67% and ash content from 2.68 – 3.92% on dry weight basis. Grass pea contained sodium, potassium, zinc and manganese in the range from 18.76 – 44.14 mg/100g, 710 – 1060 mg/100g, 3.03 – 5.01 mg/100g and 1.10 – 1.81 mg/100g on dry weight basis respectively. Tannin, phenol, flavonoid, phytic acid and BOAA/ODAP content of grass pea genotypes ranged from 5.58 – 8.39 mg/g, 0.27 to 2.15 mg GAE/g, 0.02 – 0.34 mg QE/g, 5.33 – 9.57 mg/g and 0.47 – 2.23 mg/g on dry weight basis respectively. Of the eleven grass pea genotypes used in the study, Prateek, Ratan and Mahateora showed significant low amount of BOAA/ODAP content.

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**Abstract of Ph. D. thesis**

**Department: Agricultural Biochemistry**

**Major Adviser: Dr. Khanin Pathak**

## **Biochemical Characterization of Major Nutritive Components In *Hylocereus Costaricensis***

*Rahul Sen*

Dragon fruit commonly known as pitaya or kamalam is non-climacteric perennial climbing fruit of *Hylocereus* genus of the Cactaceae family thought to have originated from the tropical forest region of Mexico and Central and South America. Fruit is gaining popularity among both the consumers (because of their high nutritional and pharmacological values, attractive vibrant colour, exotic appearance, appealing flavour and palatable texture) and farmers (due to their adaptation in a wide range of environments, low maintenance and high cost to return ratio). However, there is scanty of information available about the complete nutritional profile of the dragon fruit. Current systematic research was designed and executed to generate biochemical data to support the nutritional superiority of the fruit. In the present study, nutritional, biochemical, and proximate data for the two-dragon fruit (*Hylocereus*) species *H. costaricensis* (red pulp) and *H. udantus* (white pulp) from the seven days of fruit set to fruit maturity was generated. Physical parameters such as length, diameter, weight, and volume of the fruit gradually increased, and the percentage of peel decreases throughout the development process. A hundred grams of fresh matured fruit of both *H. costaricensis* and *H. udantus* was found to provide  $0.52 \pm 0.02$  and  $0.42 \pm 0.04$ g crude fat,  $2.40 \pm 0.12$  and  $3.21 \pm 0.16$ g dietary fiber,  $4.04 \pm 0.03$  and  $4.64 \pm 0.05$ g crude protein,  $8.40 \pm 0.06$ g total soluble sugar,  $3.42 \pm 0.07$  and  $3.19 \pm 0.10$ g reducing sugar,  $0.46 \pm 0.02$  and  $0.32 \pm 0.03$  g starch,  $2.60 \pm 0.29$  and  $2.44 \pm 0.29$  g total soluble protein, 313.13 and 319.71mg potassium, 10.67 and 46.57mg magnesium, 6.29 and 7.52mg iron, 74.94 and 93.71mg calcium, 6.85 and 12.98mg sodium, 7.63 and 5.01mg zinc, 0.34 and 0.39mg copper and 0.56 and 0.63 mg manganese, respectively. Variation in the fatty acid profile of seed and pulp of fruit was observed. Seed and pulp of *H. costaricensis* fruit were found to contain a total of eighteen and twelve fatty acids respectively, *H. udantus* however harbour only six (in seed) and twelve (pulp) fatty acids among which arachidonic acid was found to be in the highest amount. The edible portion of mature fruit of both the species was found to contain an adequate amount of four fat-soluble (A, D, E, K) and five water-soluble vitamin B (B1, B2, B3, B6, and B9). Total seven

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organic acids were identified and quantified among which malonic acid (66.42  $\mu\text{g}/100\text{g}$ ) was predominant in *H. costaricensis* and citric acid (85.62  $\mu\text{g}/100$ ) in *H. udantus*. Pigment stability analysis performed for one week under dark conditions revealed that the pulp of *H. costaricensis* contained a significantly higher amount of betacyanin pigment than the peel, which was found to be stable in slightly acidic pH (pH 4-6), sugar solution (5% sorbitol, 10% glucose, 10 % fructose, 10% sucrose and 10% maltose), 0.5% antioxidant solution and low temperature. Also, the pigment was found to be heat, light, and salt labile. Pulp of 7-day old fruit of both *H. costaricensis* and *H. udantus* contained approximately 3.11 and 2.8-time high total phenolic and 2.03 and 1.46 times higher total flavonoid content, respectively than the mature fruit. A total of 15 phenolic compounds were identified using UHPLC, among which ellagic acid was predominant in the pulp of mature fruit of both *H. costaricensis* (15.38 $\pm$ 0.28 mg/100g) and *H. udantus* (22.06 $\pm$  0.22 mg/100g). In contrast, the peel was a rich source of syringic acid (33.48 $\pm$ 1.97 mg/100g) in *H. udantus* and ferulic acid (32.25 $\pm$ 2.32 mg/100g) in *H. costaricensis* fruit. Antioxidative activity measured using DPPH, FRAP, TAC, and ABTS method reveal that the seven-dayold fruit exhibit higher antioxidant potential than the mature fruits. Further, a pioneer work of the generation of the first DNA barcodes of both the species using candidate barcoding genes (matK, rbcL, PSBA, atpH-atpF, rpoC1, and trnL) in the northeast region of the country was performed.

# **Optimization of in vitro transformation protocol and RNAi based gene silencing for viral (Cucumber Mosaic Virus) resistance in Bhut jolokia (*Capsicum chinense* Jacq.)**

*Bharati Deuri*

Bhut jolokia (*Capsicum chinense* Jacq.), one of the most popular and hottest chillies in the world, is widely cultivated in Assam and other North Eastern regions in India. A member of the Solanaceae family, Bhut jolokia is characterized by very high pungency due to the presence of high amount of phenolic alkaloid 'Capsaicinoids'. It is an ideal chilli variety for extraction of oleoresin and capsaicin, which have high market demand due to their industrial uses and medicinal properties. Bhut jolokia production is challenged by several biotic constraints, particularly viral diseases, which affect its quality and yield. Among the viruses, Cucumber Mosaic Virus (CMV) causes severe crop damage, leading to low productivity. Current control measures for CMV are mainly preventive through vector management strategies, which are not adequate in controlling the disease. An effective way to control the disease is the use of biotechnological tools such as RNA interference (RNAi) technology to engineer resistance against the virus. Plants expressing a copy of a viral gene in sense and/or antisense orientation have shown resistance upon infection with the virus via post-transcriptional gene silencing. In the present investigation, an in vitro regeneration/transformation strategy has been optimized for Bhut jolokia and, a hairpin RNA (hpRNA) based gene silencing construct has been developed using the Replicase gene from CMV. The study was initiated by callus induction from Bhut jolokia leaf segments in MS basal medium. Very good quality callus were induced in MS medium supplemented with 0.5 mg/l or 1 mg/l 2,4-D. Multiple shoot induction and regeneration from callus were obtained in MS medium supplemented with 8.5 mg/l KIN and 0.5 mg/l TDZ along with 5 mg/l AgNO<sub>3</sub> with maximum shoot initiation frequency of 95% and regeneration frequency of 90%. Root regeneration was found to be optimum in half strength MS medium supplemented with 1.5 mg/l NAA within 4 weeks of culture with maximum rooting frequency of 70%. For standardization of an Agrobacterium-mediated

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genetic transformation system, the strain LBA4404 carrying pCAMBIA1301 binary vector construct with *gusA* as the reporter gene and *hptII* and *nptII* as selection marker genes was used. Transformation was carried out using 45 days old callus and also with intact Bhut jolokia seeds as explants. Hygromycin concentration of 9 mg/l was found to be optimum for efficient selection of putative transformants. From a total of 30 nos. of callus infected by *Agrobacterium*, 9 numbers of putative transformed shoots were regenerated in presence of selection agent. Finally, only 2 (6.66%) fully rooted plants survived out of which, only 1 plant finally survived during hardening in the green house. Moreover, out of 30 nos. of infected seeds, a total of 7 numbers of putative transformed seedlings were developed. Finally, only 1 (3.33%) seedling survived, which was transferred to the green house for hardening. Thus, both callus and seeds could be used as explants for transformation in Bhut jolokia, although the frequency of putative transformants obtained using callus explants was higher than that in seed transformation. The putative transformants were confirmed by GUS histochemical assay and PCR analysis. For developing the RNAi construct, a 323 bp Replicase gene sequence was cloned into pHANNIBAL vector both in sense and anti-sense orientations. The construct was then transferred to pBI121 binary vector, which was electroporated into *Agrobacterium* strain LBA4404 for plant transformation. Functional validation of the CMV Replicase hp-RNA construct was done through bioassay in model plant *Nicotiana benthamiana* by Agro-infiltration. Transgene expression in *N. benthamiana* was confirmed by RT-PCR analysis. The bioassay results indicated suppression of CMV infection in Agro-infiltrated *N. benthamiana* plants when mechanically inoculated with CMV sap. Further, DAS-ELISA established the functional efficiency of the hpRNA construct in providing considerable level of resistance against CMV infection. The in vitro regeneration-transformation strategy and the hpRNA based gene silencing construct, developed through this study would serve as a foundation towards future studies on engineering resistance against CMV in Bhut jolokia.

# **SSR marker based genetic diversity analysis and differential transcriptome in deepwater rice of Assam**

*D Shephrou Helena*

Deepwater rice (*Oryza sativa*), locally known as baodhan, is an important crop in the flood plains of Brahmaputra valley and Barak valley of Assam. A deepwater flood is a large-scale flood lasting for a prolonged period with water levels that range from a few to several meters. Deepwater rice adapts to submergence by rapidly elongating its internodes and thereby maintaining its leaves above the water surface. It hides this unique ability in its genome and uses it during a water emergency. The remarkable, rapid growth in response to water depth is a unique biological and environmental adaptation in deepwater rice which is known as an escape strategy. At present, there is inadequate evaluation data, no concerted effort to evaluate the genetic diversity and less exploration of this traditional landraces at molecular level. A set of 92 deepwater rice germplasm of Assam were genotyped using 74 SSR markers to assess the genetic diversity and genetic relationship. A total of 139 alleles was amplified with an average of 2.48 alleles per locus and the PIC value ranged from a low of 0.18 (RM413) to 0.69 (RM206) with a mean value of 0.39. Cluster analysis grouped these varieties into seven clusters. Analysis of molecular variance (AMOVA) revealed that 96% of the total variation observed in this germplasm came from within the populations, while 4% of the variation emanated among the populations. The biochemical analyses revealed the significant increased activity of anaerobically induced enzymes. Furthermore, to understand the insight of molecular mechanisms underlying the internode elongation of deep water rice, whole genome transcriptomics study was initiated. KEGG annotation revealed the enrichment of differentially expressed genes in several metabolic pathways including plant hormonal signal, secondary metabolite, cysteine-methionine and tryptophan. Among DEGs identified, most interestingly, we found the upregulation of genes like ERFO65, ERF051, ACO2, SAUR31, CYP93G2 and downregulation of ERF3 (ERF076), ACO1, WRKY21, ABA8OX3, JA1 in internodal and nodal tissues signifies the possibility of its involvement role in imparting adaptability to Negheri Bao rice in

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response to deepwater stress. Among the transcription factor genes, the ERF family genes were expressed especially at high levels during submergence. Our results highlight the genes that contribute to the essential mechanisms of deep-water tolerance in rice, including carbohydrate metabolism, pyrophosphate-dependent energy conservation, and ethylene signaling pathways.

## **Mapping of Quantitative Trait Locus (QTL) for drought tolerance in rice**

*Kaldate Rahul Chandrakant*

Drought is a major abiotic constraint for rice production worldwide. The reproductive stage drought stress (RSDS) leads to a huge loss in grain yield. The prospecting of new donor cultivars with identification and introgression of large effect drought tolerance related QTLs is essential to develop drought-tolerant rice varieties. The present study was conducted with the aim of mapping quantitative trait locus (QTLs) associated with drought tolerance in rice. With a total of 3417 GBS (Genotyping by sequencing) based polymorphic SNP (Single nucleotide polymorphism) markers distributed over the rice chromosomes a saturated linkage map spanning 1924.136 cM was constructed with an average marker density of 0.56 cM using an F3 mapping population developed by crossing traditional Ahu rice cultivar Koniahuh (drought tolerant) with Disang (drought susceptible). Using inclusive composite interval mapping (ICIM) approach 172 genomic regions associated with grain yield and related traits were detected in 198 F3 and F4 segregating lines evaluated for two consecutive seasons under both RSDS and irrigated control conditions. Of which, 102 QTLs were identified under RSDS with LOD (Logarithm of odds) score value ranging between 2.53 to 7.51 and phenotypic variance explained (PVE) value of 1.97 to 12.42 per cent. While 70 QTLs with LOD score value ranging between 2.50 to 10.07 and PVE value of 2.35 to 11.46 per cent were detected under control condition. In total, nine QTLs were major QTLs having a PVE value 10. Among the QTLs identified under RSDS, 72 (70.59%) QTLs were novel whereas 30 (29.41%) QTLs were observed to be co-localized or overlapped with genomic regions previously mapped for the same trait/ QTLs. Five putative QTLs namely, qGY2.00, qGY5.05, qGY6.16, qGY9.19, qGY10.20 were found to be associated with grain yield under drought. Further, fourteen CAPS (Cleaved Amplified Polymorphic Sequences) were developed from selected eight novel QTLs linked SNP regions and validated in parental cultivars along with ten F5 generation RILs. Putative gene identification within eight QTL regions detected a total of 3341 genes in which 1516 (45.63%) genes were annotated to at least one gene ontology (GO) term. The putative QTLs and candidate genes identified in the present study need to be further validated, which will be helpful for the improvement of drought tolerance in rice.

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## **A study of retrograde signaling in pigeon pea (*Cajanus cajan*) during the interaction with *Helicoverpa armigera***

*Meshram Swapnilkumar Adeshkumar*

Communication between cell organelles is required to maintain cellular homeostasis, which plays a crucial role in the growth and development of plants based on environmental cues. Interorganellar communication (retrograde and anterograde signaling) is affected by changes in nuclear gene expression during biotic and abiotic stresses. In the current investigation, the effect on retrograde signaling of a moderately resistant cultivar (ICPL-332) and a susceptible cultivar (ICPL-87) of pigeon pea after the application of *Helicoverpa armigera* oral secretion (OS) was studied using both transcriptomic and biochemical approaches. Based on the results, it was found that reactive oxygen species (ROS) accumulated in both cultivars after 12 hrs of OS application (simulated herbivory) which confirmed the activation of the defense response. Furthermore, the whole transcriptome assay revealed that a total of 2473 DEGs were common in both the cultivars out of which 851 genes were upregulated and 1458 genes were down-regulated. DEGs for retrograde signaling pathways and those associated with chloroplast and mitochondrial activities were identified. It appeared that ROS scavenging enzymes (ascorbate oxidase, zeaxanthin epoxidase, and superoxide dismutase) were highly expressed in both the cultivars. Expression of nuclear-encoded mitochondrial genes (mitochondrial uncoupling protein, mitochondrial import inner membrane translocase, electron transport flavoprotein, NAPD-ubiquinone oxidoreductase, and mitochondrial RhoGTPase) was found to be higher in ICPL-332 due to simulated herbivory but genes (hydroperoxidelyase, allene oxide isochorismate synthase) responsible for the biosynthesis of volatile compounds such as JA, SA in both cultivars, however, levels of expression were found to be higher in susceptible cultivar, ICPL-87. Genes involved in retrograde signaling (tetrapyrrole binding protein, transcription activator GLK1 (GOLDEN2-LIKE) Executor 2, and triose phosphate/phosphate translocator) were differentially expressed in both cultivars. Interestingly, simulated herbivory impacted negatively on the retrograde signaling of the

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susceptible cultivar ICPL-87. Consequently, the expression of the chlorophyll a/b binding of the light-harvesting complex (LHCB) which is regulated by GLK1 was downregulated in ICLP-87 within 8 hrs of simulated herbivory. In the case ICPL-332, the impact was less significant and LHCB protein levels were found to be increased after 8 hrs and 24 hrs. In ICPL87, expression of LBCH protein and genes of primary metabolites was lower which resulted in upregulation of various secondary metabolite (terpenoid& flavonoid) pathways. ICPL-87 induced several genes for volatiles (hydroperoxidelyase, allene oxidase, etc.) and secondary metabolites, however, the retrograde signaling of ICPL87 was severely affected. In ICLP-87, the downregulation of mitochondrial and plastidal genes could be due to poor communication between these organelles and the nucleus during simulated herbivory. Based on this study it appeared that the response to simulated herbivory was more robust in moderately tolerant cultivar, ICPL-332 compared to ICLP-87. The present study provided evidence for the first time that interorganellar communication is also affected during herbivory defense in pigeon pea.



## **Mapping of drought tolerant QTLs in upland rice variety Banglami**

*Nabarun Roy*

The study entitled ‘Mapping of drought tolerant QTLs in upland rice variety Banglami’ was taken up to identify the drought tolerant QTLs in Banglami, a local medium duration upland low yielding landrace of Assam which is drought tolerant. For this a mapping population was developed by crossing Banglami with Ranjit, an elite long duration high yielding photosensitive and drought susceptible variety of Assam. QTL mapping was done in this population with the use of SSR markers by Verma et al. (2017a) and Sharma et al. (2017) and several QTLs were mapped. But with the demand of latest technology which needs QTLs within narrow confidence intervals so that they can be used precisely in any breeding programme without much problem of linkage drag, the present work done became demanding as Genotyping by sequencing (GBS) technology was used to find out SNP markers which will now flank the mapped QTLs. For this, the mapping population was evaluated for 2 consecutive seasons for several yield and agronomic traits under both reproductive stage drought stress and control condition. The phenotypic data collected was associated with genotypic data to form a high density/saturated linkage map. 4646 polymorphic informative SNPs were assigned to 12 linkage groups (LGs) covering a total of 1306.424 cM of the rice genome at an average marker distance of 0.32 cM.

A total of 65 QTLs were mapped which explained a PVE of 1.95- 13.80% with LOD scores ranging from 2.5- 31.6, out of which 30 QTLs were mapped from stress data, whereas 35 QTLs were mapped from non stress data. Out of these only 5 QTLs were major QTLs and 2 QTLs were found to be stable across environments. 3 QTLs were mapped for the trait grain yield per plant (GYP). 10 QTL clusters were identified among which cluster no. 10 on chromosome no. 12 had a congregation of 8 QTLs together within a region of 29 cM and can be considered as a QTL hotspot. Six genes within the QTL regions were found to be differentially expressed under stress condition. The genes were Calcium-transporting ATPase 9, Phosphoinositide binding protein, Histone demethylase JARID1C, Nuclear-pore anchor and OsWAK3 – OsWAK receptor-like cytoplasmic kinase and Cytochrome P450. Overall results from the present

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study sets a good achievement within the science of molecular breeding and can give a strong scientific background for the future researchers, the outcomes of which can help them to develop drought tolerant rice varieties.

## **Characterization of the *Sinapis alba*-*Alternaria brassicicola* interaction and, identification of associated defense response genes**

*Reshma Ahmed*

*Alternaria* blight caused by *Alternaria brassicicola* is one of the most devastating and widespread fungal diseases of the oilseed mustards. It causes yield losses up to 47% and has been reported from various parts of the country including the state of Assam. The non-host *Sinapis alba*, wild relatives of Brassicaceae, has been reported to have resistance against *Alternaria* blight disease. In order to understand this non-host mechanism, isolation and identification of pathogen, morphopathological, screening for resistance both in vitro and in vivo, histopathological study by using Scanning Electron Microscopy (SEM) and global gene expression using next generation sequencing method(NGS), RNA-seq, has been done to develop resistance variety of rapeseed mustard against *Alternaria* blight. For this, infected leaves, siliques and stems of the Toria variety TS-38, showing the initial conspicuous characteristic symptoms of *Alternaria* blight, were collected for isolation of the pathogen. The infected plant parts were surface sterilized and inoculated in petriplates containing Potato Dextrose Agar (PDA) medium under optimal conditions for fungal growth and sporulation. The mycelial growth of the fungus was observed after 3days of inoculation and the hyphal growth covered the petriplates within 15days of inoculation. On the basis of the conidial morphology as observed through microscopic studies, the pathogen was identified as *Alternaria brassicicola*. Purification of the fungal pathogen was done by single spore isolation method. Further, molecular detection of the fungus was successfully carried out by amplification of the fungal genomic DNA using reported ITS primers (ITS1/ITS2 & ITS2/ITS4). Sequencing of the fungal ITS region also confirmed the pathogen at the genus level. Further confirmation upto species level has been done with *A. brassicicola* specific primers (ABS28). The primary screening test both in vitro detached leaf assay showed the development of infection by showing chlorotic region after 72hpi with no chlorosis in *S. alba*. The light microscopy study of the infected portion showed the appearance of increase number fungal filaments in *B. rapa* with a few filaments in *S. alba*. The trypan blue staining showed the increase level of necrosis in *B. rapa* in

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comparison with *S. alba*. The SEM analysis also showed a similar type of result with light microscopy with a less hyphal penetration with a few spores in comparison with *B. rapa* by the presence of mass of hyphal filament with increased number of spores. Further Pathogenicity test was performed in vivo that showed successful development of disease in *B. rapa* after 72hpi whereas the infection developed after 7dpi in *S. alba*. The disease progression study by morphological study showed a slow and restricted with little infection in *S. alba* after 10dpi whereas in *B. rapa* with severe infection with complete death of the inoculated leaves within that period. The disease scoring has been studied from 0hrs to 10 days. Leaf disease incidence percentage (LDI%) was calculated that analyzed the number of incidence of spot after infection. LDI% for *B. rapa* was found to be 82.50% while in *S. alba* it only showed 15% after 10dpi which is very less and showed its resistance against *A. brassicicola*. Global transcriptome profile has been done at early infection period viz. 48 and 72 hours post inoculation to identify the genes responsible for its resistance by differential expression study of genes in both the cultivars. A mapping percentage of 79.41% and 78.46% was found in *S. alba* after 48 and 72hpi and of 96.63% and 92.87% was found in *B. rapa* after 48 and 72hpi. DEG analysis showed a large number of genes were up-regulated at 48hpi than 72hpi. Validation of transcriptome data was performed by selecting 12 defense related genes that showed a high fold change in *S. alba* in comparison with *B. rapa* which showed a similar trend that confirms the validation of the targeted data set.

# **Morphogenetic, Metabolic and Molecular Dynamics during Mycelial Interactions among Fungal specie**

*Samim Dullah*

In nature, microorganisms interact/compete with one other for food and space and the type of interactions are unique to each interacting species. Fungal-fungal interactions are complex, and different types of secondary metabolites are secreted during interaction. In this study, 14 fungal isolates were facilitated in 105 possible combinations to interact in potato dextrose agar (PDA). Ten interactions between different fungal isolates showed mutual replacement with each fungus; capturing territory from the other. Thirty-five interactions showed complete replacement as growth of one of the fungal partners was inhibited. In forty-six interactions, formation of barrage was observed leading to deadlock type of interaction wherein both fungi have restricted growth. The barrage formation during interaction was further studied with two fungal interactions viz., (i) *T. coccinea* vs. *L. lactinea* and (ii) *T. coccinea* vs. *T. versicolor*. Microscopic changes were observed in the hyphal growth during interaction like hyphal coiling, dense mycelial network, pore formation. Fungal-fungal interaction often leads to the change in metabolite profile of both the interacting fungus which may have potential implication in industry or agriculture. The metabolites produced during interaction of *Trametes coccinea* (F3) with *Leiotrametes lactinea* (F9) and *Trametes coccinea* (F3) with *Trametes versicolor* (F1) was analysed through Liquid Chromatography coupled with Mass Spectroscopy (LC-MS). Most of the metabolites secreted during interaction are associated with defensive response. The bipartite fungal interaction resulted in the production of a dark brown colour pigment – melanin as confirmed by the LC-MS, FTIR and NMR analysis. Moreover, the fungal-fungal interaction also led to increase in the production of laccase, a group of multicopper oxidases involved in detoxification of toxic compounds. Further increased activity of superoxide dismutase, an enzyme that catalyzes the dismutation of the superoxide anion to hydrogen peroxide was also recorded during fungal–fungal interaction. There was significant increase in the activities of hydrolytic enzymes including cellulase, xylanase and chitinase during in vitro fungal-fungal interaction, suggesting the importance of

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such interactions for commercial enzyme production. Quantitative real-time PCR revealed upregulation of *lcc1* (encoding a laccase enzyme) and few other stress related genes of *T. versicolor* during its hyphal interaction with *T. coccinea*, suggesting a direct correlation between laccase production and melanin production. The study helped to gain a better understanding on the morpho-physiological, biochemical and gene expression profiles during in vitro fungal-fungal interaction. Such interactions induce the production and secretion of an array of metabolites and enzymes which can be prospected towards biotechnological applications.

## **Consumer preference towards Ayurvedic product in Assam**

*Debasis Kalita*

The present study examined the awareness of consumer towards different brands of ayurvedic product, factors influencing brand preference of consumers and level of consumer satisfaction towards ayurvedic products. The study was conducted in the Jorhat district of Assam. A random sampling technique was used for the purpose of selecting 80 consumers from 8 retail stores for detailed investigation. Necessary information pertaining to the objectives of the present enquiry were collected during 2020-21 from the selected consumers through pre tested structured schedules following survey method. Tabular analysis was used in verifying different aspects of the study to achieve the desired objectives. The results of the study revealed that majority of the respondent were of the age group between 35-45 years with graduate level education and most of them were service holder. The income level of maximum respondent was between “30000- 45000” income level categories. Most of the respondents belong to nuclear family with family size of below 5 members. Majority of the respondents were aware of Patanjali brand which was followed by Himalaya and Dabur. Shopkeepers/retailers were the major source for getting information about the brands followed by news paper and television. Majority of the respondents were planned buyer and the respondent purchased products of all the categories whenever necessary. Most preferred brands of ayurvedic food product, baby product, health care products were Dabur and Patanjali while for cosmetic products Himalaya and Biotique were the most preferred brand. Brand image was the main factor that influenced the consumers to prefer a particular brand for ayurvedic products. Better quality also plays an important role in influencing the consumers to prefer and stick to a particular brand of their choice. The other important factors that influence brand preference of ayurvedic product were flavour, quality, eco friendly, chemical free, preservative free, long relief, more nutritious, reasonable price of the products etc. Packaging design were comparatively less important factors that influence brand preference. Maximum numbers of respondent were highly satisfied with different products under broad categories viz, ayurvedic food products, health care products, baby products and cosmetic products. The major factors

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responsible for consumer satisfaction towards ayurvedic food product were brand image followed by better quality and health factor. In case of ayurvedic health care product, brand image, better quality and traditional based were the major factors while brand image followed by better quality, herbal ingredient were the factors responsible for ayurvedic baby product. With regards to consumer satisfaction towards ayurvedic cosmetic product brand image followed by better quality and long relief were found to be the major factors. The major reasons for consumer dissatisfaction towards ayurvedic product were non availability, higher price and less awareness.



# **Interzonal Variation of Farm Mechanisation in Assam**

*Horindra Gogoi*

Farm mechanisation plays vital roles in reduction of drudgery of the human labour and drought animals, enhancement of the cropping intensity, precision and timeliness of efficiency of utilisation of various crop inputs and reduction of the losses at different stages of crop production through the use of the use of various power sources and improved farm tools and equipments. With growing of pace of farm mechanisation, questions arise on the issues such as degree of adoption and regional variation in the extent adoption of those modern farm machineries and equipments, resource and energy use efficiency, agricultural technology adoption and comparative economic advantage as a result of adoption of different types of farm mechineries. With this point of views, the present study was undertaken in Assam with the specific objectives viz., 1) Examine the extent of adoption of farm mechanisation across different agro climatic zones of Assam, 2) Study the impact of farm mechanisation on technology adoption and energy use, 3) Analyze the resource use efficiency and comparative economics of farm mechanisation and 4) Identify the constraints of farm mechanisation.

The study was conducted in five agro climatic zones in Assam (viz., Upper Brahmaputra Valley Zone (UBVZ), North Bank Plain Zone (NBPZ), Central Brahmaputra Valley Zone (CBVZ), Lower Brahmaputra Valley Zone (LBVZ) and Barak Valley (BVZ). The sampling design adopted in the study was multistage stratified random sampling design .A sample of 100 farmers was collected for each of the five agroclimatic zones in the ratio of 4 marginal: 3 small:2 medium :1 large so as to make the total sample size 600.

The results of the study revealed that the overall mechanization farm was 86 per cent in selected agroclimatic zones of Assam, while 14.00 per cent farms were operating with traditional practices of farm operations by using bullock and manual labour. The highest percentage of mechanization was observed in NBPZ (89.17 per cent) followed by CBVZ, UBVZ, BVZ and LBVZ accounting for 86.67 per cent, 85.83 per cent, 85.00 per cent and 83.33 per cent, respectively. Among the different categories of farm

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mechanization, on an average, tractor hired farms (THF) occupied the highest percentage (50.97 per cent) followed by power tiller hired farms (PTHF), power tiller owned farms (PTOF) and tractor owned farms (TOF) with the percentage of 37.02, 7.95 and 4.07 respectively. operation wise extent of farm mechanization showed that on an average, the primary tillage/ ploughing, threshing and transportation were the major operations mechanised by 86.00 per cent, 79.83 per cent and 53.39 per cent farmers respectively, while interculture operation, irrigation, harvesting and winnowing and bagging were mechanised by 10.83 per cent, 27.00 per cent, 7.12 per cent and 31.83 per cent farmers respectively.

Adoption of HYV of Sali paddy (in terms of number of farmers) was found to be highest in CBVZ (96.15 per cent) and lowest in UBVZ (81.55 per cent) among the mechanized farm, while in non mechanized farm 33.33 per cent farmers adopted HYV Sali rice, In mechanized farm, HYV Sali rice was adopted in 77.06 per cent area as against only 39.31 per cent for non mechanized farms. HYV seed of mustard, black gram, potato, boro rice and jute in mechanised farm was adopted by 53.62 per cent, 40.74 per cent, 37.93 per cent, 65.69 per cent and 76.47 per cent farmers respectively, while for non mechanised farm, it was observed 16.95 per cent and 40.00 per cent for mustard and jute respectively. On the other hand, HYV seed of Sali rice, mustard, black gram, potato, boro rice and jute in mechanised farm was adopted in 77.96 per cent, 66.61 per cent, 46.53 per cent, 45.74 per cent, 62.24 and 66.82 per cent area respectively, as against 39.31 per cent, 16.51 per cent and 44.83 per cent for Sali rice, mustard and jute respectively in non mechanised farm. Line transplanting practices in Sali rice, was followed only in 6.19 per cent area in mechanised farm as against 4.37 per cent for non –mechanized farms. Among the various agroclimatic zones, line transplanting in Sali rice in mechanised farm was adopted in 2.51 per cent, 6.17 per cent, 10.11 per cent, 11.12 per cent and 2.44 per cent area respectively in UBVZ, NBPZ, CBVZ, LBVZ and BVZ. On the other hand, line transplanting in Boro rice was adopted in 30.46 per cent, 57.09 per cent, 69.61 per cent, 67.01 per cent and 65.17 per cent area respectively in UBVZ, NBPZ, CBVZ, LBVZ and BVZ with the overall adoption of 57.43 per cent. Adoption of chemical fertilizer in Sali rice, mustard, black gram, potato, boro rice and jute in mechanised farm was found in 44.74 per cent, 64.19 per cent, 21.33 per cent, 39.05 per cent, 68.30 per cent and 63.45 per cent area respectively as against 15.15 per cent, 16.43 per cent and 13.71 per cent area for Sali rice, mustard and jute respectively in non mechanised farm. Chemical methods of plant protection measure was adopted in Sali rice, mustard, black gram, potato, boro rice and jute under mechanised farm in 47.37 per cent, 21.65 per cent, 18.99 per cent, 64.98 per cent, 62.25 per cent and 69.52 per cent area respectively as against 22.91 per cent, 6.78 per cent and 4.29 per cent area for Sali rice, mustard and jute respectively in non mechanised farm.

The average energy utilised for cultivation of Sali rice, mustard, blackgram, potato, boro rice and jute was 5217.27 MJ/ha, 4488.17 MJ/ha, 2612.70 MJ/ha, 13293.43 MJ/ha, 11204.74 MJ/ha, and 7082.61 MJ/ha respectively in mechanised farm as against 5050.65 MJ/ha, 3846.70 MJ/ha and 6352.25 MJ/ha for Sali rice, mustard and

jute respectively in non-mechanised. Various energy efficiency ratios revealed that energy was efficiently utilised in cultivation of all the crops both in mechanised and non-mechanised farm. Of course, mechanized farms were observed to be more efficient than non mechanized farms from the point of energy utilization. Average human labour and seed utilisation was less in mechanised farm as compared to non mechanised farm for crops under study, whereas per hectare utilisation of fertilizer, manure, plant protection chemicals and micro nutrients was found less in non-mechanised farm than the mechanised farm.

Utilisation of human labour in Sali rice, mustard, black gram, potato, boro rice and jute in mechanised farm was found in 86.26 Man days, 42.55 Man days, 53.56 Man days, 99.34 Man days, 96.87 Man days and 172.57 Man days respectively as against 117.75 Man days, 80.41 per cent and 190.30 Man days for Sali rice, mustard and jute respectively in non mechanised farm.

The results of regression analysis for factors affecting crop production revealed that in mechanised farm in UBVZ, seed, fertilizer and machine labour significantly and positively affected the farm income, whereas in non-mechanised farm, FYM and fertilizer were found to be positive and statistically significant. In NBPZ, fertilizer, irrigation and machine labour in mechanised farm, and seed and human labour in non-mechanised farm were found statistically significant. For CBVZ, seed, FYM, irrigation and machine labour affected farm income significantly in mechanised farm, as against fertilizer and bullock labour in non-mechanised farms. In case of LBVZ, fertilizer, irrigation and machine labour were found significant in mechanised farms, while seed and fertilizer were significant in non-mechanised farms. Area, seed, FYM and machine labour significantly contributed to farm income in mechanised farm in BVZ as against seed and fertilizer in non-mechanised farms.

Study on the comparative economics of crop production in mechanized and non mechanised farm revealed that the average cost of cultivation per hectare at Cost C2 in Sali rice, mustard, black gram, potato, Boro rice and jute under mechanized farm was Rs.46349.32, Rs.28745.28, Rs.25287.79, Rs.98827.93, Rs.55439.25 and 88580.06 respectively, as against Rs.48386.80, Rs.30540.22 and 92675.21 respectively for Sali rice, mustard and jute in non mechanised farm. Gross return per hectare was estimated at Rs. 63913.25, Rs.31771.69, Rs. 35613.16, Rs.147107.39, Rs.69403.90 and Rs.118218.18 respectively for Sali rice, mustard, black gram, potato, Boro rice and jute under mechanised farm, while it was Rs. 54817.88, Rs.29059.80 and Rs.110363.54 respectively for Sali rice, mustard and jute in non –mechanised farm. Per hectare net return in Sali rice, mustard, black gram, potato, Boro rice and jute under mechanized farm was Rs.12928.40, Rs.151.88, Rs.7796.59, Rs.38396.66, Rs.6420.41 and 20780.11 respectively, as against Rs.1592.40, Rs.4534.44 and 8420.81 respectively for Sali rice, mustard and jute in non mechanised farm.

Lack of sufficient own funds to meet initial high costs of farm machinery, and lack of adequate credit facilities and rigid repayment norms were the common major problems faced by farmers in all the selected agro-climatic zones. Among all problems,

lack of sufficient own funds to meet initial high costs of farm machinery occupied the 1st rank as faced by 90.83 per cent farmers.

# **Crop Insurance in Odisha: An Empirical Assessment” submitted by Saddam Hossen Majumder**

*Saddam Hossen Majumder*

The present study identified and quantified the various risks, performance of crop insurance schemes in Odisha and assessed the impact of its adoption along with the prioritization of risk mitigation strategies adopted by the rice growers. The study used primary as well as secondary data and primary data was collected from 240 farmers comprising both insured and non-insured farmers selected from two districts, namely Jagatsinghpur and Kendrapara from East and South eastern coastal plains zones of Odisha, where rice cultivation and climatic related hazards, both are widespread. Few officials and field functionaries of implementing agencies were also selected and interviewed. The study revealed that farmers in Odisha state and the study area as well are much vulnerable to adverse climatic environments, especially floods, drought, severe cyclones and infestation of pest and diseases. Farmers do have their own risk coping strategies like sale of farm produce/ livestock and non-farm activities (daily wage labour) apart from adoption of crop insurance. Crop diversification as a tool of risk reduction also examined through various indices and it was found that insured farmers were in better position to diversify their crops than the non-insured farmers. Growth analysis of earlier introduced insurance schemes showed that farmers and area coverage, farmers covered and benefitted, premium paid and claims settled, etc. decreased except National Agricultural Insurance Scheme (NAIS) in which growth of above indicators were positive during kharif seasons for loanee farmers. The present scheme Pradhan Mantri Fasal Bima Yojana (PMFBY) introduced during 2016, replacing earlier schemes were also examined and found loanee and non-loanee farmers’ coverage got increased during kharif season, but percentage coverage of loanee farmers was much higher than non-loanee farmers. Post revamp of PMFBY scheme witnessed increase in the number of non-loanee farmers during rabi 2020-21. However, compensations against crop damages were much lower than the average value of threshold yield. The results also depicted that the farmers were reluctant to invest more

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due to frequently occurrence of adverse climatic risks but they spend more in material costs in rice production anticipating high yield and compensation in case of any catastrophes, and the fact was reinforced by significant regression coefficient of insurance adoption on materials costs. To estimate the true impact of crop insurance, the difference in difference (DiD) method was employed and found a negligible difference between increment in costs, returns and investment on agriculture between insured and non-insured farmers. Estimates of logit regression models showed that farm size, farmer's contact with extension agencies, access to credit, information access from media and influence of fellow farmers were the key drivers of awareness creation and adoption of crop insurance. Estimates of tobit regression model indicated that gross cropped area, credit availed, affordability of farmers to premium rate and diversification status of farm, etc. were the key factors influencing the premium paid by the insured farmers. Delay in conducting crop cutting experiments (CCE), damage assessment and settlement of claims were the main hindrances for adoption of crop insurance as identified and ranked using Garrett ranking technique. Creation of awareness about benefits of crop insurance and considering the individual farm as a unit of assessment instead of gram panchayat were the key suggestion for better coverage of the scheme. It is concluded that a demand driven approach comprising of location specific crops and coverage, targeting young and educated farmer and easy access to information flow through better extension services will facilitate more adoption and improve the farmer's stands in protecting their crops from various adversities.

# **Determinants of Production Instability, Efficiency and Supply Chain Management of Spices in North East India**

*Soibam Peter Singh*

India is the largest producer and exporter of ginger to more than 50 countries more particularly in the Middle East countries, Germany and France. Turmeric is the 3rd important commercial spice of India after chilli and garlic and it is named as “Indian saffron. Large cardamom is native to Bhutan and India and the global production is concentrated only in these three countries in the Indian sub-continent which is grown organically. Sikkim is the largest producer of large cardamom in India contributes about 88 percent of the total production of the country. The present investigation was undertaken with a view to: (i) estimate the magnitude and direction of growth pattern of spices (ii) examine the nature of production instability and identify the sources (iii) study the resource use efficiency and economics of spices production (iii) analyze the supply chain and associated problems in spices production and marketing. The study was primarily based on both perennial and seasonal spices crops viz, ginger, turmeric and large cardamom. For ginger and turmeric, Karbi Anglong and Dima Hasao districts of Assam was selected purposively while for large cardamom, North Sikkim and West Sikkim district was selected from the state Sikkim. For ginger, a total of six villages were selected randomly making a total 90 growers and also for turmeric, 90 growers were selected randomly from six villages. Similarly, for large cardamom 90 growers were selected from the two districts of Sikkim. Thus, a total of 270 growers of different categories were made for the three crops. For marketing, Diphu and Manja market of Karbi Anglong district and for Dima Hasao district Haflong and Maibang market were selected randomly for ginger and turmeric. Again for large cardamom, Hee Bazar and Gyalsing market was selected West Sikkim district and for North Sikkim district, Singtam and Mangan Bazar were selected randomly. The data on price were collected from the farmers as well as from the market players. Primary data were collected for the agriculture year 2019-20 and secondary data were collected from the records maintained by the National Horticulture Board, Govt. of India. Mainly, tabular analysis was done

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and simple average, standard deviation, variance and coefficient of variation were calculated. For estimation of resource use efficiency, regression analysis was done using Cobb-Douglas production function. The results of the study revealed that the NER experienced a positive growth rate in area, production and yield of ginger, turmeric and total spices. However, the 8 region witnessed a negative growth rate in area, production and yield in large cardamom. The instability index for ginger, turmeric and large cardamom revealed low instability as compared to all India level. The area effect was found to be the major driving force for contribution in the change in output of major spices. Estimation of cost and return witnessed that in ginger and turmeric cultivation marginal farm size achieved the highest benefit while small farm size in cultivation of large cardamom benefitted Distant Wholesaler/→ Village Merchant →most. In channel I, both ginger (Producer consumer)→ Retailer → Processor → Wholesaler →consumer) and turmeric (Producer was found to have major share in the total sales whereas for large cardamom channel III Distant wholesaler/consumer) was most preferred channel→ Wholesaler →(Producer by the producer in disposing their produces. Channel IV was found to have the highest marketing efficiency in all the three crops under study. The major problem faced by the spices growers in the region are shortage of labour, pest and diseases and low productivity. In marketing high price fluctuation was the major issues confined to the spices growers in the region. With a view to cope up these constraints emphasis should be given on the expansion of more areas under major spices, availability of improved quality planting materials is pre-requisite for enhancing the production and income of farmers. Institutional and extension support such as hands on training, demonstration, field visit should be provided to develop skill, capacity building and confidence among the farmers so as to enhance the productivity is the need of the hour.



# **Economic Analysis of Homegarden Biodiversity in Assam**

*Zafrina Hussain*

Home garden as the name says is usually a small area of land surrounding a household, where members of the family grows varieties of vegetables, medicinal crops, fruits trees and trees which can be ornamental and so on and is commonly known by the name baari in Assam, in rural household apart from growing vegetables and fruits in their home garden they rear live stocks, cattle's and fishes as well hence there exist a noticeable biodiversity in a baari, however in urban residents misses this opportunity and is limited to fruits and vegetables for meet the family food requirements . Home gardening is also known by the name homestead gardening as it surrounds the home of the household. Almost every household may it be a rural household or an urban dwelling household both has a garden either their vegetable garden or kitchen garden which is a miniature form of farm plots growing vegetables and herbs in small area and so in small scale. Household grows vegetables, herbs and also fruits in pots and containers to meet their day to day culinary needs. It is often a structured space having a visual appeal all the year round. In today's human civilization when there are constant threat to the climate and environment home garden is a boon as it serves the environment with greeneries which provides fresh air, bears with the pollution by reducing carbon emission, provides fresh vegetables grown all organically, usually using compost manures, because it is practiced in small scale so the use of chemical fertilizers are negligible. It is also a source of rare and extinct varieties of fruits and herbs which have established medicinal properties. Therefore, to cope up with environmental issues urban civilization practices roof top gardening unlike their rural counterparts as small step to a big environmental issue and also to meet with their nutrition requirement.

The present study is an attempt to assess the existing status of biodiversity in the home gardens of few randomly selected villages in five Agro climatic zones of Assam. All the five Agro climatic zones have different characteristics in terms of rainfall pattern, terrain and soil, so does the biodiversity, however the most commonly found biodiversity component have been studied and assessed in terms of economical analysis

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where in the species richness, its abundance, and its density is studied, the economics of resources used in the home gardens, the role of gender in management of the home gardens, and assessing the contribution of homegarden biodiversity in livelihood.

This study was conducted in randomly selected homegardens of Jorhat (Upper Brahmaputra Valley Zone), Morigaon (Central Assam Zone), Karbi Anlong (Hill Zone), Sonitpur (North Bank Plain Zone), and kamrup district (Lower Brahmaputra Valley Zone) of Assam. An inventory of crop species and livestock diversity component in home gardens was prepared and a comparative study using Shannon- wiener index the diversity of species was evaluated and the relative importance value, density and abundance was calculated for the selected home gardens from five different Agro climatic zones. The study categorised the composition of species as components into trees, vegetables, fruits, spices, medicinal plants, and livestock for biodiversity inventory. Thus excluding for example ornamental species, which do not relate immediately to livelihood.

A total of 144 plants species belonging to 64 families were recorded from the survey of 290 gardens across the five selected Agro climatic zones of Assam. An average of 34 plant species were found in each homegardens surveyed for the study which included vegetable species, tree species, medicinal plant species, and spices and condiments. The smallest homegardens in the present study had a Shannon index with 1.30, but they were not significantly different from the indices reported for the medium and large (1.21, 1.24, respectively), while the total of 144 species recorded in the study. When the production and consumption ratio was studied across the Agro climatic zones, it is seen that the production and consumption ratio was found to be the highest in the homegardens of the North Bank Plain Zone which was 0.76, followed by the homegardens of the Lower Brahmaputra Valley Zone which was 0.72, respectively. Usually incomes from smaller homegardens is less as compared to the larger homegarden because larger garden have profit motive with higher composition of commercial plant species while in smaller gardens composition of commercial crops is less. The percentage contribution of homegardens towards household's average annual gross income was 43.33 per cent.

Female headed homegardens were significantly higher in size than male headed homegardens in the small sized homegardens and medium sized homegardens in this study. Among the three homegarden size categories 53.00 per cent were female headed in small sized homegardens 59.00 per cent female headed in medium sized homegardens and 57.00 per cent in large sized homegardens.

## **Management of potassium in organic black rice under system of rice intensification**

*Ashok Sambhaji Dambale*

A field experiment entitled “Management of potassium in organic black rice under system of rice intensification” was conducted at the organic block, Instructional-cum-Research Farm of Assam Agricultural University, Jorhat during kharif seasons, 2019 and 2020 to evaluate the effect of different organic inputs on growth, yield, quality and economics of organic black rice along with cumulative effects on soil health under the system of rice intensification (SRI). The experiment consisted of twelve different treatments viz., Control (T1), Potash solubilizing bacteria (KSB) @ 3.5 kg ha<sup>-1</sup> as root dip treatment (T2), RDK through azolla incorporation (T3), RDK through water hyacinth incorporation (T4), RDK through banana pseudo stem vermicompost (T5), RDK through azolla incorporation + mustard oil cake @ 20 kg ha<sup>-1</sup> (T6), RDK through water hyacinth incorporation + mustard oil cake @ 20 kg ha<sup>-1</sup> (T7), RDK through banana pseudo stem vermicompost + mustard oil cake @ 20 kg ha<sup>-1</sup> (T8), RDK through azolla incorporation + Potash solubilizing bacteria (KSB) @ 3.5 kg ha<sup>-1</sup> as root dip treatment (T9), RDK through water hyacinth incorporation + Potash solubilizing bacteria (KSB) @ 3.5 kg ha<sup>-1</sup> (T10), RDK through banana pseudo stem vermicompost + Potash solubilizing bacteria (KSB) @ 3.5 kg ha<sup>-1</sup> (T11), Indigenous traditional knowledge (T12). The experiment was laid out in a Randomized Block Design (RBD) with three replications. The soil of the experimental site was sandy loam in texture with pH 5.28, organic carbon (0.72 %), CEC {6.58c mole (p+)/ kg}, low in available nitrogen (246.45 kg ha<sup>-1</sup>) and available P<sub>2</sub>O<sub>5</sub> (21.02 kg ha<sup>-1</sup>) but medium in available K<sub>2</sub>O (144.80 kg ha<sup>-1</sup>). The total rainfall received during the crop season was 928.2 mm with 43 rainy days in 2019 and 1272.10 mm with 69 rainy days in 2020. The mean maximum and minimum temperature during the whole crop growing period ranged from 30.6 to 21.3°C during 2019 and 32.09 to 24.28 °C during 2020, respectively. The growth, yield attributes and yield of organic black rice was significantly influenced by different K management practices. Among the different growth parameters viz., leaf area index, no. of leaves, root dry weight, shoot dry weight, root: shoot ratio, root length, root volume, no. of tillers and dry matter accumulation except plant height at different stages were

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observed to be significantly higher with the application of RDK through banana pseudo stem vermicompost + mustard oil cake @ 20 kg ha<sup>-1</sup> i.e. treatment T8, while the lowest values were recorded under the control treatment T1. In case of yield and yield attributing characters like, no. of panicles m<sup>-2</sup>, panicle length, panicle weight, no. of filled and unfilled grains and test weight were found to be superior in respect of almost all the studied parameters under the treatment T8. The highest no. of panicles (m<sup>-2</sup>) 294.10, 305.20, panicle length 27.49 (cm), 28.87 (cm), panicle weight 4.87 (g), 4.89 (g), no. of filled grains panicle<sup>-1</sup> pooled 214.53, no. of unfilled grains panicle<sup>-1</sup> pooled 26.73 and test weight 24.48 (g) 24.56 (g), respectively during 2019 and 2020 were also found highest with treatment T8. The highest pooled grain (24.52 q ha<sup>-1</sup>), straw (46.07 q ha<sup>-1</sup>) and biological yield (70.59 q ha<sup>-1</sup>) were registered with the treatment T8 i.e. RDK through banana pseudo stem vermicompost + mustard oil cake @ 20 kg ha<sup>-1</sup>. The quality parameters of black rice were also significantly influenced by different K management practices. The quality parameter includes length and breadth of kernel, L/B ratio, protein content and milling qualities. The maximum quality parameters were found highest under treatment T8 (RDK through banana pseudo stem vermicompost along with 20 kg of mustard oil cake) followed by T6 (RDK through azolla incorporation along with mustard oil cake @ 20 kg ha<sup>-1</sup>) except protein content where as highest protein content (7.96 during 2019 and 7.98 % during 2020) was found under treatment T6 (RDK through azolla incorporation + mustard oil cake @ 20 kg ha<sup>-1</sup>) followed by T9 (RDK through azolla incorporation along with Potash solubilizing bacteria @ 3.5 kg ha<sup>-1</sup>). The N, P and K contents and total uptake by grain and straw were significantly influenced by different K management practices. The highest uptake of N (65.74 kg ha<sup>-1</sup>) was found in T6, P (11.4 kg ha<sup>-1</sup>) and K (39.56 kg ha<sup>-1</sup>) were found in T8 respectively. The influence of different organic inputs on available N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O in soil after harvesting was found significant. The highest pooled value of available N was recorded with T6 treatment i.e. RDK through azolla incorporation + mustard oil cake @ 20 kg ha<sup>-1</sup> and in case of P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O the highest pooled values recorded under T8 treatment i.e. 43.07 kg ha<sup>-1</sup>, 159.86 kg ha<sup>-1</sup> respectively. The soil biological properties and enzymatic activities of black rice cultivated soil were significantly influenced by different organic inputs. The higher values of soil microbial biomass carbon (642.77 µg/g dry soil during 2019 and 687.44 µg/g dry soil during 2020, Bacteria population (7.12 log cfu/g soil during 2019 and 7.18 log cfu/g soil during 2020, fungal population (4.86 log cfu/g soil during 2019 and 4.89 log cfu/g soil during 2020, dehydrogenase activity (67.19 µg TPF/g/day during 2019 and 69.52 µg TPF/g/day during 2020) and Phosphomonoesterase activity (78.61 µg PNP/g/hr 2019 and 79.48 µg PNP/g/hr during 2020) were reported with application of RDK through banana pseudo stem vermicompost along with mustard oil cake @ 20 kg ha<sup>-1</sup> (T8) followed by application of RDK through azolla incorporation along with mustard oil cake @ 20 kg ha<sup>-1</sup> (T6). In the present investigation, the gross monetary return (₹.127136), net monetary return (₹.79136) and B:C ratio (2.65) were found to be highest under T8 treatment i.e. RDK through banana pseudo stem vermicompost + mustard oil cake @ 20

kg ha<sup>-1</sup> and the lowest were recorded under T1 treatment. Based on the findings of two years study on management of potassium in organic black rice under system of rice intensification, it may be concluded that among all treatments T8 (RDK through banana pseudo stem vermicompost + mustard oil cake @ 20 kg ha<sup>-1</sup> ) was found best closely followed by treatment T6 (RDK through azolla incorporation along with mustard oil cake @ 20 kg ha<sup>-1</sup> ) with respect to reap good economic yield with better quality, sustain the soil health and high net return and were found beneficial as potash source to substitute recommended dose of potassium in organic cultivation of black rice under agro-ecological situation of Assam.

## **Nutrient and weed management in rice-rice cropping sequence**

*Gayatri Kumari*

A field experiment entitled “Nutrient and weed management in rice-rice crop sequence” was conducted in ICR Farm of Assam Agricultural University, Jorhat, with autumn and winter rice varieties, Luit and Ranjit, grown in sequence for two years, 2018 and 2019. The investigation, laid out in randomized block design (factorial) with three replications, aimed to study the impact of nutrient and weed management on growth and yield attributes of rice, weed dynamics and changes in soil microbiota. The treatment consisted of four Nutrient managements viz. T1-100% N-P2O5-K2O through inorganic fertilizers (recommended dose of 40-20-20 kg/ha), T2-75% N through inorganic + 25% N through FYM (P2O5 & K2O recommended doses), T3-75% N through inorganic + 25% N through vermicompost (P2O5 & K2O recommended doses) and T4- 75% N through inorganic + 25% N through Crop residues and bio-fertilizer (P2O5 & K2O recommended doses); three weed management treatments viz: W1-Pyrazosulfuron @ 25g/ha + 2,4-D @ 0.5kg/ha in both autumn and winter rice, W2-Pyrazosulfuron @ 25g/ha + 2,4-D @ 0.5kg/ha in autumn rice rotated with Pretilachlor @ 0.75 kg/ha + 2,4-D @ 0.5kg/ha in winter rice and W3-Pyrazosulfuron @ 25g/ha + 2,4 –D @ 0.5kg/ha in autumn rice and only Pretilachlor @0.750kg/ha in winter rice; and two controls viz: C0- Absolute control and C1- Farmer’s practice [(0.750 kg/ha pretilachlor + N-P2O5-K2O (20-10-10 kg/ha)]. Soil of the experiment site was sandy loam in texture, slightly acidic (pH-5.6) in reaction, medium in organic carbon (0.65%), available N (222.63 kg/ha), available P2O5 (21.18) and available K2O (127.71 kg/ha). The results of the two years of experiment indicated that among the nutrient management treatments, significantly higher growth attributes, yield attributes, N-P2O5-K2O content and NPK uptake by rice was observed with treatment T3 (75% N through inorganic + 25% N through vermicompost) and the lowest was observed lowest in treatment T1 (100% N-P-K through inorganic fertilizers) in both the years of autumn and winter rice. Two years of pooled data showed that yield was significantly highest in treatment combination of T3W2 (75% N through inorganic+ 25% N through vermicompost along with Pyrazosulfuron @ 25g/ha + 2, 4-D @ 0.5kg/ha in autumn rice rotated with Pretilachlor

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@ 0.750 kg/ha + 2,4-D @ 0.5kg/ha in winter rice) in both the years for autumn (3627 kg/ha and 3637.44 kg/ha respectively) and winter rice (3770.7 kg/ha and 3735.2 kg/ha respectively). Significantly lowest weed fresh weight and dry weight, weed density, weed frequency, and relative dry weed weights, with respect to grasses, 7 sedges and broad leaved weeds were observed in treatment T4 (75% N through inorganic + 25% N through crop residues and bio-fertilizer) in both the years of autumn and winter rice. Among the weed management treatments, W2 (Pyrazosulfuron @ 25g/ha + 2,4-D @ 0.5kg/ha in autumn rice rotated with Pretilachlor @ 0.75 kg/ha + 2,4-D @ 0.5kg/ha in winter rice) was observed with the lowest weed fresh weight and dry weight, weed density, weed frequency, and relative dry weed weights, with respect to grasses, sedges and broad leaved weeds. The results pertaining to metagenomic study of bacterial and fungal population suggested that there were considerable changes in the population for both the microbes from 0 DAT to physiological maturity due to the nutrient and weed management treatments. The observed changes as indicated by their Operational taxonomic units (OTUs) percentage, Alpha diversity and Beta diversity indices are also indicative of having their direct or indirect impact on soil fertility status. In the present investigation, highest value in terms of agronomic efficiency, nitrogen use efficiency, energy output, energy productivity ratio, energy efficiency index and was highest in the treatment combination of T3W2 (75% N through inorganic+ 25% N through vermicompost along with Pyrazosulfuron @ 25g/ha + 2, 4-D @ 0.5kg/ha in autumn rice rotated with Pretilachlor @ 0.750 kg/ha + 2,4-D @ 0.5kg/ha in winter rice) in both the years for autumn and winter rice. Also, the same treatment combination, i.e., T3W2 (75% N through inorganic+ 25% N through vermicompost along with Pyrazosulfuron @ 25g/ha + 2, 4-D @ 0.5kg/ha in autumn rice rotated with Pretilachlor @ 0.750 kg/ha + 2,4-D @ 0.5kg/ha in winter rice) showed the highest net return for autumn rice (Rs.42412.99 and Rs. 40972.99 respectively) as well as winter rice (Rs. 59864 and Rs. 58833.9 respectively) of both the years. B: C ratio was also observed to be highest in treatment combination of T3W2 (75% N through inorganic+ 25% N through vermicompost along with Pyrazosulfuron @ 25g/ha + 2, 4-D @ 0.5kg/ha in autumn rice rotated with Pretilachlor @ 0.750 kg/ha + 2,4-D @ 0.5kg/ha in winter rice) in both the years of autumn (3.22 and 3.12 respectively) and winter rice(4.63 and 4.56 respectively). Thus, from the above observations, it can be incurred that application of 75% N through inorganic+ 25% N through vermicompost along with Pyrazosulfuron @ 25g/ha + 2, 4-D @ 0.5kg/ha rotated with Pretilachlor @ 0.750 kg/ha + 2,4-D @ 0.5kg/ha, can be considered as the best practice of nutrient and weed management for rice-rice cropping sequence in the prevailing 8 conditions of Assam. It is, however, needed to be practiced in multi- locational trials in order to obtain a much better understanding, conclusion and feasibility before recommending to the farmers. Further investigations to study the impact of the inorganic herbicides and nutrients on the soil microbial population is also required so that they are, accordingly, recommended to the farmers, with the long term motive of maintaining sustainability of soil in addition to focusing upon increasing productivity and meeting the population demands.

## **Intercropping of quality protein maize and toria under different nutrient levels and planting density**

*Meghna Sarma*

A field experiment “Intercropping of quality protein maize and toria under different nutrient levels and planting density” was conducted at the Instructional cum-Research Farm of AAU, Jorhat during the rabi season of 2017-18 and 2018- 19. The soil of the experimental site was sandy loam in texture with acidic in reaction (pH 5.34), medium in organic carbon (0.61%), medium in available nitrogen (308.65kg ha<sup>-1</sup>), high in available phosphorus (35.59 kg ha<sup>-1</sup>) and medium in available potassium (198.54 kg ha<sup>-1</sup>). The experiment was laid out in factorial RBD with 3 replications. The treatment consisted of three fertility levels (F1:60-40-40 kg ha<sup>-1</sup> N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O, F2:90-60- 60 kg ha<sup>-1</sup> N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O and F3:120-80-80 kg ha<sup>-1</sup> N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O), three paired row spacing (S1:55cm x 25cm, S2:65cm x 25cm, S3:75cm x 25 cm) with two methods of sowing (P0: Normal sowing, P1: Paired row sowing). Maize variety Vivek QPM-9 and toria variety Jeuti (JT-90-1) were selected for maize + toria intercropping. Experimental findings revealed that among different fertilizer levels, 120-80-80 kg ha<sup>-1</sup> N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O (F3) differed significantly with respect to growth parameters of quality protein maize like plant height, number of leaves per plant, dry matter accumulation, crop growth rate, leaf area index during both the years of experimentation. In case of yield attributes significantly higher yield attributes like higher number of cobs per plant, cob length, cob girth, 1000-grain weight were recorded for 2017-18 and 2018-19. Fertilizer dose of 120-80-80 kg ha<sup>-1</sup> N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O (F3) had resulted the highest grain yield of 51.42 q ha<sup>-1</sup> and stover yield of 89.14 q ha<sup>-1</sup> when pooled over two years followed by the next higher dose of fertilizer viz., N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O @ 90-60-60 kg ha<sup>-1</sup> (F2) in both the years. Pooled analysis of maize equivalent yield was found to be significantly affected by the highest dose of fertilizer i.e. N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O@ 120-80-80 kg ha<sup>-1</sup> with an yield of 55.83 q ha<sup>-1</sup>. In case of N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O content and uptake by grain and stover in quality protein maize, highest values were recorded under N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O @ 120-80-80 kg ha<sup>-1</sup> for both the seasons. Available N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O after harvest of maize + toria intercropping was significantly higher in plots treated with N,

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P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O @ 120-80-80 kg ha<sup>-1</sup> for both the years followed by N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O @ 90-60-60 kg ha<sup>-1</sup>. Soil moisture content at 90 days after sowing was significantly influenced by 120-80-80 kg ha<sup>-1</sup> of N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O application. Soil depth of 15-30 recorded higher values of moisture content as compared to 0-15 cm depth in two consecutive years. Light transmission ratio (LTR) was maximum in plots with the highest dose of fertilizer viz., N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O @ 120-80-80 kg ha<sup>-1</sup> in all the stages i.e. vegetative, reproductive and at harvest during both the years. In intercrop 7 toria, growth parameters, yield attributes, pooled seed (4.67 q ha<sup>-1</sup>) and stover yield (13.06 q ha<sup>-1</sup>) were found to be significant and the highest was recorded due to F3 treatment (N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O @ 120-80-80 kg ha<sup>-1</sup>) applied to the main crop maize for both the years. Among the paired row intercropping, row spacing of 75cm (60/90) x 25cm resulted in significantly higher growth parameters of maize whereas row spacing 65cm (40/90) x 25 cm recorded the highest yield attributing characters and highest pooled grain of 50.31 q ha<sup>-1</sup> and stover yield of 89.98 q ha<sup>-1</sup> of quality protein maize. The highest maize equivalent yield of 53.79 q ha<sup>-1</sup> was obtained at a row spacing of 65cm (40/90) x 25 cm when pooled for two years. Similarly, NPK uptake by grain and stover and available N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O were significantly higher due to paired row spacing of 65 cm (40/90) x 25 cm for both the years. Highest values of LTR recorded at vegetative stage of crop in row spacing of 65 cm (40/90) x 25 cm for two years consecutively. In intercrop toria, growth parameters, yield attributes, seed yield (pooled-4.57 q ha<sup>-1</sup>) and stover yield (pooled-13.05 q ha<sup>-1</sup>) were found to be significant and recorded highest due to row spacing of 65 cm (40/90) x 25 cm for both the years. For results in method of sowing, normal row sowing was found to be the highest with pooled grain yield of 49.22 q ha<sup>-1</sup> and stover yield of 89.98 q ha<sup>-1</sup> with higher N, P and K uptake. However, paired row sown crop recorded the highest maize equivalent yield (pooled-52.84 q ha<sup>-1</sup>) as well as soil moisture contents were found to be superior in normal row sown crop at 30 and 90 days of sowing. In terms of economics, maximum gross return Rs.97707.22 ha<sup>-1</sup>, net return of Rs.64194.22 ha<sup>-1</sup> and B-C ratio of 2.91 were recorded in the treatment level of N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O @ 120-80-80 kg ha<sup>-1</sup>. Paired row spacing of 65cm (40/90) x 25 cm recorded maximum gross return of Rs.94127.53 ha<sup>-1</sup>, net return of Rs.63246.53 ha<sup>-1</sup> and B-C ratio of 3.05 in maize + toria intercropping. In method of sowing under paired row intercropping, the highest mean gross return of Rs.92478.46 ha<sup>-1</sup>, net return of Rs.60922.46 ha<sup>-1</sup> and highest B- C ratio of 2.93 was recorded. The performance of maize + toria intercropping was assessed on the basis of maize equivalent yield, monetary returns and B-C ratio as well as soil nutrient status. In respect of all the above assessment, application of nutrient level N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O @120-80-80 kg ha<sup>-1</sup> was found to be the best dose of quality protein maize for obtaining higher productivity along with toria as intercrop with optimum paired row spacing of 65cm (40/90) x 25cm.

## **Forage productivity of ryegrass (*Lolium multiflorum*)- cowpea fodder sequence under different irrigation regimes and nitrogen levels**

*Nilotpal Hazarika*

A field experiment entitled “Forage productivity of ryegrass (*Lolium multiflorum*)- cowpea fodder sequence under different irrigation regimes and nitrogen levels” was carried out at the Instructional-cum-Research (ICR) Farm, Assam Agricultural University, Jorhat during 2017-2018 and 2018-2019. The experiment was laid out in split- plot design with three replications. The treatments consisted of five levels of irrigation in main plot viz., I0: Rainfed, I1: Irrigation at critical growth stages, I2: Irrigation at IW: CPE ratio of 1.0, I3: Irrigation at IW:CPE ratio of 1.2 and I4: Irrigation at IW:CPE ratio of 1.4 along with four levels of N- N0: 0 kg N/ha, N1: 30 kg N/ha, N2: 60kg N/ha and N3: 90 kg N/ha in sub- plots. The soil of the experimental site was sandy loam in texture, acidic in reaction, medium in organic carbon, medium in available N, available P<sub>2</sub>O<sub>5</sub> and low in available K<sub>2</sub>O. Results revealed that irrigations at IW:CPE ratio of 1.4 resulted in higher growth in terms of plant height, number of tiller per sqm, number of leaves per sqm, green fodder yield, dry matter yield and crude protein yield in all three cuts viz. 1st, 2nd and 3rd cut as compared to other irrigation levels. The higher values of N uptake, evapotranspiration and total water use were also observed under these treatments. The higher gross and net returns with higher B:C ratio were found under the irrigation regime IW:CPE=1.4. The treatment receiving N levels 90 kg/ha had significant effect in almost all the growth and yield parameters. Application of 90 kg N/ha resulted in higher value of green fodder yield, dry matter yield and crude protein yield and was found to be statistically significant as compared to other levels of N (30 kg and 60 kg N/ha). The evapotranspiration and total water use and water use efficiency of the crop were also higher under these treatments. An economic analysis showed that application of 90 kg N/ha recorded the comparatively higher gross return, net returns and B:C ratio. Interaction effect of levels of irrigation and nitrogen were found to be significant in respect of parameters like plant height, number of tiller per sqm, number of leaves per sqm, green fodder yield, dry matter yield and crude protein yield. In the succeeding crop, no significant effect was found among the treatment so far growth characters, green fodder yield, dry matter yield and crude protein yield to different treatment effects of the preceding crop.

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**Major Adviser: Dr. K. K. Sharma**

## **Study on diversity of rice in Nagaland and their suitability to changing climate**

*Merentoshi*

The present investigation was carried out during the year 2018 to 2020 to evaluate the performance of some rice (*Oryza sativa* L.) genotypes from Nagaland under different CO<sub>2</sub> and temperature regimes viz., Treatment I = Field (control), treatment II = (CO<sub>2</sub> (550±20ppm) + Temp. of 40 C > ambient) and Treatment III = CO<sub>2</sub> (750±20ppm) + Temp. of 60 C > ambient) under fully automated bioreactors with CO<sub>2</sub> and temperature control facilities in Stress Physiology Laboratory, Department of Crop Physiology, Assam Agricultural University, Jorhat-13. In the first experiment, 75 rice genotypes collected from different locations of Nagaland were subjected for initial screening for tolerance against elevated CO<sub>2</sub> and temperature out of which 7 genotypes were selected for further study on their response mechanism of tolerance by comparing with the national check variety N22. The results revealed that treatment II had a positive impact on the various morpho-physiological parameter viz., plant height, number of leaves, leaf area index, root volume and length, membrane stability index, total leaf chlorophyll content, leaf nitrate reductase activity, proline in all the genotypes whereas a declining trend indicating the deleterious effect of high temperature, at a higher CO<sub>2</sub> and temperature in treatment III was observed in all these parameters. Similarly, significant variation in photosynthesis and its related parameters (viz. stomatal conductance, internal CO<sub>2</sub>, transpiration) affected the photosynthetic rate and their partitioning to root, shoot and reproductive organ under both the treatments as compared to field condition. These factors ultimately contributed to growth efficiency and yield of the plant. Amongst the treatments, significant increase of H<sub>2</sub>O<sub>2</sub>, MDA content was recorded in treatment III as compared to treatment I. Kohima Special and N22 recorded lower H<sub>2</sub>O<sub>2</sub> and MDA when compared to other local genotypes. Hence these two genotypes could maintain their plant water status as evidenced by their higher MSI under both the treatments. The maintenance of higher plant water status in Kohima Special and N22 could be attributed to their higher RLWC and increased compatible solutes viz. proline content and non structural carbohydrate contents. Further, studies in tolerance indices indicated that among the tested local genotypes, Kohima Special and

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Lisem were tolerant whereas Tatza and Tzumma showed to be most susceptible under high temperature. In the molecular analysis, using SCoT molecular markers out of 77 bands amplified, 55 were found to be polymorphic with 68.99 per cent polymorphism. Only four primers SCoT28 and SCoT34 not found to be polymorphic alleles, while remaining 23 SCoT primers showed both polymorphic alleles. Yield and yield attributing characters are governed by all the morphological, physiological and biochemical processes. Among yield parameters, 1000-grain weight, spikelets per panicle and total grain weight per plant were significantly higher due to elevated CO<sub>2</sub> at treatment II since the genotypes could maintain a higher photosynthetic rate and had a superior plant defence mechanisms but were significantly decreased under high temperature at treatment III which was negatively influenced by all the processes resulting in decrease in yield and yield attributing characters in all the genotypes.

## **Diversity of Ants in Some Selected Ecosystems of Assam**

*Banashree Medhi*

The present study on diversity of ants was carried out in four different ecosystems of Assam viz., fruit, vegetable, forest and tea during 2017-2020. A total of 32 species of ants belonging to 16 genera under 6 subfamilies were collected from aforementioned ecosystems. Out of 32 identified species, 6 species have been found to be new records from Assam viz., *Camponotus invidus* Forel, 1892, *C. buddhae*, Forel, 1892, *Polyrhachis bicolor* Smith F., 1858, *P. fortis*, Emery, 1893, *P. rupicapra* Roger, 1863 and *Dolichoderus feae* Emery, 1889. Subfamily Formicinae exhibited the highest numbers species (14) followed by Myrmicinae (8), Dolichoderinae (5), Ponerinae (2), Pseudomyrmecinae (2) and Dorylinae (1). Results showed, forest ecosystem harboured the maximum numbers of ant species (19) followed by tea (13) and fruit (12) whereas, minimum number was observed in vegetable ecosystem (7). The sampling of ant species was carried out in five fruit ecosystems viz., citrus, mango, jackfruit, litchi and banana. Among these, the citrus ecosystem harboured the maximum (9) numbers of ant species while least number of species was registered from litchi and jackfruit ecosystems (3 each). Collections of ant specimens for vegetable ecosystem were carried out in potato, tomato and chilli ecosystem during winter whereas collection was done from French bean and cowpea during summer. Each vegetable ecosystem harboured 3 numbers of species except potato ecosystem where 2 species were recorded. Studies on diversity of ants were carried out in 3 forest ecosystems viz., Pobitora wildlife sanctuary, Nambor wildlife sanctuary and Gibbon wildlife sanctuary. The Gibbon wildlife sanctuary registered 15 numbers of species while 10 numbers of species were found in Nambor and Pobitora wildlife sanctuaries. In case of tea ecosystem, altogether 11 numbers species were recorded from 3 organic estates whereas only 7 numbers species were found from 3 inorganic tea estates. Formicinae was observed to be the most abundant subfamily under fruit (40.6%), forest (42.1%) and tea (35.6%) ecosystems. However, Dolichoderinae (45.8%) was the most abundant subfamily in vegetable ecosystem followed by Myrmicinae (28.1%), Formicinae (14.2%), Ponerinae (8.3%) and Dorylinae

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(3.5%). The forest ecosystem followed similar trend as fruit ecosystem. However, subfamily Ponerinae (9.0 %) was least abundant. Similarly in tea ecosystem, Myrmicinae (23.3%) was second most abundant subfamily followed by Pseudomyrmecinae (19.6%), Dolichoderinae (18.4%) and Ponerinae (3.3%). The species *Oceccophylla smaragdina* was the most abundant and dominant species in fruit (26.6%) and tea ecosystem (18.7%). However, *Tapinoma indicum* and *Camponotus invidus* were the most abundant and dominant species in vegetable (39.3%) and forest (13.7%) ecosystem, respectively. The Shannon-Wiener Index was recorded to be higher during summer (2.08, 1.49, 2.76, and 2.17) while lower during winter (1.99, 1.45, 2.72, and 1.75) in fruit, vegetable, forest and tea ecosystems, respectively. The Simpson Index of Diversity values ranged between 0.74-0.93 ( $>0.5$ ) indicated high species richness in all 4 ecosystems during both winter and summer. The species evenness of all 4 ecosystems also recorded the values closer to 1 ( $E= 0.80-0.94$ ) indicated equal distribution of the individuals in all the four ecosystems during both the seasons. Furthermore, the values of Shannon-Wiener Index, Simpson Index of Diversity & Evenness ranged between  $H'=1.06-1.10$ ,  $SID = 0.65-0.68$  &  $E= 0.96-0.99$ , when measured in French bean and cowpea ecosystem in summer. In winter the values of Shannon-Wiener Index, Simpson Index of Diversity and Evenness ranged between  $H'=0.67-1.08$ ,  $SID=0.46-0.66$  and  $E= 0.61-0.98$ , when recorded in chilli, potato and tomato ecosystem. The highest diversity was recorded in Gibbon wildlife sanctuary during both summer and winter while lowest was measured in Nambor wildlife sanctuary. The organic tea ecosystem quantified higher value of diversity during both winter ( $H'=2.20$  and  $SDI=0.88$ ) and summer ( $H'=2.11$  and  $SDI=0.86$ ) seasons whereas lower values were recorded from inorganic tea ecosystem (winter  $H'=2.20$  and  $SDI=0.88$ , summer  $H'=1.83$  and  $SDI=0.83$ ). The morphometric study of all 32 species revealed that *Pseudoponera rufipes* measured ( $15.149\pm0.706$  mm) highest total body length whereas *Tapinoma indicum* ( $0.332\pm0.017$  mm) measured the least. The cephalic capsule length and cephalic capsule width was recorded to be maximum in case of *Carbera diversa* ( $3.703\pm0.137$  mm and  $3.073\pm0.137$  mm) whereas least in *T. indicum* ( $0.031\pm0.001$  mm and  $0.02\pm0.001$  mm). Among all the species, the antennal length was recorded highest in case of *Polyrhachis fortis* ( $6.617\pm1.841$ mm) while least in *Monomorium pharonis* ( $0.205\pm0.055$ mm). The principal component and canonical correspondence analysis morphometric characters revealed that the specimens of *T. rufonigra* documented from fruit and tea ecosystem were morphometrically similar and clearly distinguished from forest ecosystem. The total body length and cephalic capsular length of *T. rufonigra* were positively correlated in forest ecosystem. The specimens of *O. smaragdina* documented from vegetable exhibited a clear morphometric difference than the rest of the three ecosystems. The specimen of *O. smaragdina* from fruit ecosystem exhibited higher positive correlation in term of cephalic capsule length. The specimens of *C. invidus* from Nambor wildlife sanctuary were morphometrically varied from the two forest ecosystems. The specimen of *C. invidus* from Pobitora wildlife sanctuary exhibited higher negative correlation in term of cephalic capsule length and

total body length. The specimens of *T. indium* were morphometrically varied from in forest, vegetables and fruit ecosystems. The specimen of *T. indium* from vegetables and forest exhibit higher positive correlation in term of cephalic capsule length and while fruit ecosystem exhibit negative correlation

## **Ecofriendly management of *Lepidiota mansueta* Burmeister (Coleoptera: Scarabaeidae) in potato**

*Dumala Sravani*

Laboratory and field experiments were carried out at Soil Arthropod Pest Laboratory, Department of Entomology, Assam Agricultural University, Jorhat and in the farmer's field at Maharichuk, Majuli, Assam to study ecofriendly management of *Lepidiota mansueta* Burmeister (Coleoptera: Scarabaeidae) in potato during 2019-21. Efforts were also made to test the pathogenicity of different entomopathogens and to know their effects on haemocytes in *L. mansueta* as well to evaluate some newer insecticides against the grubs. While studying the pathogenicity of different entomopathogens for their virulence against third instar *L. mansueta* grubs, *Beauveria bassiana* (formulation: KR855715) recorded highest mortality (76%) of grubs followed by 72 per cent mortality in *B. brongniartii* (formulation: BbUASB16) and 70.67 per cent in *Bacillus thuringiensis* (formulation: Bio-Bt) at 30 days after treatment (DAT). The *Metarhizium anisopliae* based formulation (Bio-Meta) registered the highest LT50 value (23.05 days) (FL 19.24- 30.33) whereas the lowest LT50 value was 12.15 days (FL 11.15-13.11) in case of *B. bassiana* (KR855715). Five different haemocytes were identified based on differences in size, shape, morphology and dye-staining properties of cell and nucleus and were functionally categorized as Prohaemocytes (PRs), Plasmacytes (PLs), Granulocytes (GRs), Spherulocytes (SPs) and Oenocytes (OEs). The Total Haemocyte Count (THC) and the population of PRs, GRs, PLs, OEs and SPs were affected in response to *B. bassiana* (KR855715). The application of *B. bassiana* (KR855715) in addition to abnormal haemocyte counts also caused great abnormalities to the haemocytes by distortion of the plasma membrane, cytoplasmic extension, rupturing of cell wall, oozing out of cell contents, degranulation of the cells, vacuolation, enlargement of cells and abnormal staining of the haemocytes. Immunologically activated haemocytes in *L. mansueta* showed significant cellular immune responses such as phagocytosis, encapsulation and nodulation in response to *B. bassiana* (KR855715). The toxicity of 10 numbers of insecticides against *L. mansueta* grubs was assessed by following both film method and soil incorporation method under

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laboratory conditions. In case of film method, chlorpyrifos 20 EC @ 2.0 ml/L, quinalphos 25 EC @ 2.0 ml/L and clothianidin 50 WDG @ 1.0 g/L were found highly effective among all the insecticides tested as the above three insecticides registered cent per cent mortality of grubs after 96 hours of application. Chlorantraniliprole 18.5 SC @ 0.5 ml/L and imidacloprid 17.8 SL @ 1.0 ml/L showed 93.33 and 86.67 per cent grub mortality, respectively. The lethal effect of quinalphos was observed quickly in 19.60 hours (FL 12.72-25.87), followed by chlorpyrifos in 20.43 hours (FL 14.67-25.88) and clothianidin in 28.10 hours (FL 19.08-37.50). However, the highest LT50 was recorded at 95.98 hours (FL 69.52-180.87) in case of fipronil 5 SC @ 1.0 ml/L. Experimental findings as regards to soil incorporation method revealed that amongst all the insecticidal treatments, chlorpyrifos 20 EC @ 2.0 ml/L (46.67, 66.67 and 83.33%), quinalphos 25 EC @ 2.0 ml/L (43.33, 58.33 and 78.57%), clothianidin 50 WDG @ 1.0 g/L (36.67, 47.22 and 69.05%) and chlorantraniliprole 18.5 SC @ 0.5 ml/L (30, 44.44 and 66.67%) were significantly superior over other insecticidal treatments in recording maximum grub mortality after 24, 48 and 72 hours of exposure, respectively. The highest LT50 of 98.73 hours (FL 80.79-137.80) was recorded in fipronil 5 SC @ 1.0 ml/L and the lowest LT50 value was 27.19 hours (FL 23.32-30.49) in case of chlorpyrifos 20 EC @ 2.0 ml/L. Six different ecofriendly management modules were evaluated against *L. mansueta* grubs in potato crop. All the tested modules viz., Module-I (with only pre sowing treatment of mustard oil cake @ 150 kg/ha + wood ash @ 150 kg/ha + Panchagavya @ 3%), Module-II [pre sowing treatment plus soil drenching with neem oil @ 5 ml/L after 1st & 2nd earthing up (25 & 60 DAS)], Module-III [pre sowing treatment plus soil drenching with jatropha oil @ 5 ml/L after 1st & 2nd earthing up (25 & 60 DAS)], Module-IV [pre sowing treatment plus soil drenching with pongamia oil @ 5 ml/L after 1st & 2nd earthing up (25 & 60 DAS)], Module-V [pre sowing treatment plus soil drenching with castor oil @ 5 ml/L after 1st & 2nd earthing up (25 & 60 DAS)] and Module-VI [pre sowing treatment plus application of *M. anisopliae* @ 10 g/m<sup>2</sup> after 1st & 2nd earthing up (25 & 60 DAS)] were found to be significantly superior in reducing *L. mansueta* grub infestation as compared to the untreated control. Out of all modules, Module-VI was found to be significantly superior and recorded the lowest tuber damage on weight (11.32%) and number (14.07%) basis which was at par with Module-III which registered 11.82 and 14.78 per cent tuber damage on weight and number basis, respectively. Module-VI also registered highest tuber yield (122.71 q/ha) which was at par with Module-III (121.50 q/ha). The maximum benefit cost ratio (2.86) was recorded in Module-VI followed by Module-III (2.80) and Module-II (2.57).

## **Diversity of whitefly species and their vector status in vegetable ecosystem**

*Junmoni Gayon*

*Bemisia tabaci* (Hemiptera : Aleurodidae) is one of the limiting factors of vegetable crop production system across the world. *B. tabaci* consist of 24 morphologically indistinguishable species and also plays an important role in transmission of more than 111 plant viruses. In the present investigation, survey was conducted to screen and collect *B. tabaci* adult and immature stages from 6 different locations covering 3 agro- ecological zone of Assam during 2019 and 2020. Altogether 10 samples were collected from 3 different agroclimatic zones, which were brought to the Biocontrol Laboratory, Department of Entomology, Assam Agricultural University, Jorhat for molecular and morphological analysis. Both the laboratory and grow-out experiments to investigate the vector status were conducted, during 2019-20. The molecular study of the *B. tabaci* samples collected from different agro-climatic zones was conducted at Department of Plant Pathology, AAU, Jorhat during the year 2020. The samples of *B. tabaci* were examined for 11 numbers of morphometric characteristics in the case of female, while 10 characters in male. The result on morphometric study revealed that the females were bigger in size than of males. The sample UBZ2 collected from Pulibor, Jorhat showed outgrows in terms of measurement than that of rests. The cluster analysis divided the *B. tabaci* samples into 2 numbers of clusters on the basis of location and morphometric traits. Cluster 1 comprises the samples NBZ1, NBZ2, CBZ1 and CBZ2; while cluster 2 comprises UBZ1 and UBZ2 sample. The principal component analysis of adult *B. tabaci* revealed that the morphometrical characters of male and female could be divided into 6 principal component and principal component 1 (PC1) accounts for maximum variability of data. The molecular characterization of *B. tabaci* collected from different agroclimatic zones using primer based PCR method proves the presence of two different genetic groups. During the experimentation, the mtCOI segment of DNA was amplified at 754bp and 816bp position to determine the genetic variation in *B. tabaci*. The phylogenetic analysis revealed that the collected *B. tabaci* samples could be grouped into Asia-II 1 and Asia-II 5; where sample CBZ2 belong to Asia-II 1 and others viz., NBZ1, NBZ2, CBZ1, CBZ2

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and UBZ1 belong to Asia-II 5. Phylogenetic tree was constructed using Bayesian method and compared the sequence similarity with the sequence available in the NCBI and found 99-96% similarity. The study on seasonal abundance of *B. tabaci* was conducted in chilli during 2019 and 2020, which revealed that the population of *B. tabaci* starts appearing on chilli plants from first standard meteorological week (SMW) (i.e. 1st week of January'2019) with a population density of  $1.75 \pm 0.15$  insects /leaf during 2019. The population gives a major peak at 41st SMW (i.e. 2nd week of October) with a number as high as 90 adults per leaf. In the year 2020, the population of *B. tabaci* started to increase from 4th SMW with a population of 8 insects/leaf and reached the peak of 72 adults/leaf during 41st SMW at a maximum temperature of  $32.9^{\circ}\text{C}$ , minimum temperature of  $24.3^{\circ}\text{C}$ , morning humidity of 96%, evening humidity of 70% and rainfall 10%. The correlation study revealed that none of the abiotic factors except morning relative humidity significantly correlated with the whitefly population during both the year 2019 and in 2020. The study on the biology of *B. tabaci* on chilli and brinjal plant shows variability in duration across different developmental stages. The duration of egg, I instar, II instar, III instar and IV instar was  $4.20 \pm 0.75$ - $10.20 \pm 1.17$ ,  $1.60 \pm 0.49$ -  $5.20 \pm 0.75$ ,  $3.20 \pm 0.40$ -  $5.20 \pm 0.75$ ,  $3.00 \pm 0.63$ -  $5.60 \pm 0.49$  and  $4.80 \pm 0.75$ - $7.00 \pm 0.00$  days, respectively in chilli; while it was recorded to be  $3.00 \pm 0.00$ - $9.20 \pm 0.40$ ,  $1.20 \pm 0.40$ -  $7.00 \pm 0.63$ ,  $2.40 \pm 0.49$ - $5.40 \pm 0.49$ ,  $2.60 \pm 0.49$ - $5.80 \pm 0.40$  and  $4.00 \pm 0.63$ - $6.80 \pm 0.40$  days in brinjal, respectively. The longevity range of adult female and male in chilli was  $2.80 \pm 0.75$ - $14.00 \pm 0.89$  and  $1.60 \pm 0.49$ - $12.40 \pm 0.49$  days, respectively; while  $4.40 \pm 0.49$ -  $16.40 \pm 0.49$  and  $2.20 \pm 0.40$ - $13.80 \pm 0.75$  days, respectively in brinjal. Moreover, a total of 10 different natural enemies were also recorded to attack different developmental stages of *B. tabaci* during the course of investigation from Jorhat district of Assam. The study on transmission status of begomovirus revealed that the *B. tabaci* can acquire the disease with 1 hr feeding on infected plants with 100% of disease acquisition within 24 hrs. In an inoculation study conducted on chilli plants revealed that an inoculation access period of 1 hr was sufficient to produce disease symptoms in 4 numbers of plants out of total nine with 44.44% disease occurrence. The rate of transmission and number of infected plants was found increases with increase in inoculation time and 100% infection and transmission was found reached at 24 hrs of inoculation feeding period.

## **Toxicity of some insecticides against *Helicoverpa armigera* (Hubner) in tomato (*Lycopersicon esculentum* Mill.)**

*Phunu Mili*

The research work on ‘Toxicity of some insecticides against *Helicoverpa armigera* (Hubner) in Tomato (*Lycopersicon esculentum* Mill.)’ was carried out in the laboratory and field during 2017-2018 and 2018-2019. The laboratory studies were done in the Toxicology Laboratory, Department of Entomology. Field studies were conducted in the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat. In resistance studies the field collected population of Nagaon, Darrang and Jorhat population of *H. armigera* showed low level of resistance to very high resistance to deltamethrin (Decis 2.8% EC) imidacloprid (Admire 70% WG), chlorantraniliprole (Coragen 18.5% SC) emamectin benzoate (Pocket 5% SG) and thiamethoxam (Eco-Champ 25% WG) upto fourth generation when reared on artificial diet. Resistance Ratio (RR), showed a range of 111.5-288.9 fold, 32.87-75.40 fold, 24.92-34.73 fold, 89.72-128.66 fold and 95-183.3 fold deltamethrin, imidacloprid, chlorantraniliprole, emamectin benzoate and thiamethoxam, respectively for the *H. armigera* population collected from Nagaon. The population collected from Darrang showed a Resistance Ratio (RR) of 103.13-190.30 fold, 28.84-60.90 fold, 24.1-33.46 fold, 24.1-116 fold, 102.15-203.50 fold for deltamethrin, imidacloprid, chlorantraniliprole, emamectin benzoate and thiamethoxam, respectively. While, for Jorhat population the range of Resistance Ratio (RR) were 106.29-236.92 fold, 23.02- 63.14 fold, 10.07-34.34 fold, 10.07-88.83 fold and 98.38-168.4 fold for deltamethrin, imidacloprid, chlorantraniliprole, emamectin benzoate and thiamethoxam, respectively. The field population collected Nagaon district population showed very high resistance to deltamethrin, emamectin benzoate and thiamethoxam (RF: >100), high resistance to imidacloprid (RF: 31-100) and moderate resistance to chlorantraniliprole (RF: 11-30). In case of population collected from Darrang district, deltamethrin and thiamethoxam registered very high resistance, emamectin benzoate and imidacloprid showed high resistance and moderate resistance observed on chlorantraniliprole. However, the field

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collected population of Jorhat showed low resistance to chlorantraniliprole (RF: 2-10), moderate to emamectinbenzoate (RF:11-30), high resistance to Imidacloprid and very high resistance to deltamethrin and thiamethoxam (RF:>100). At all three places it was observed that *H. armigera* already developed very high resistance to deltamethrin and thiamethoxam. Bio efficacy studies, all the 6 treatments viz., deltamethrin @ 15 g a.i./ha, imidacloprid @ 20 g a.i./ha, chlorantraniliprole @ 10 g a.i./ha, emamectin benzoate @ 11g a.i./ha and thiamethoxam @ 26 g a.i./ha were found to be significantly superior over control (untreated). The highest population reduction was observed with the treatment of chlorantraniliprole @ 10 g a.i./ha at one (55.47%), three (75.47%), seven (85.18%), ten day (87.26%) and fifteen (87.07%) days after spraying during 2017-18 and 2018-19 whereas lowest at deltamethrin @ 15 g a.i./ha (35.74%, 49.43%, 58.58%, 63.20% and 64.25%, respectively). However, in control, population was increased by 1.97%, 4.03%, 8.52%, 10.76% and 13.90% at 1, 3, 7, 10 and 15 days after spraying. The highest mean yield was obtained from chlorantraniliprole @ 10 g a.i./ha (0.22 q/ha) followed by emamectin benzoate @ 11g a.i./ha (0.21 q/ha), thiamethoxam @ 26 g a.i./ha (0.20 q/ha), imidacloprid @ 20 g a.i./ha (0.19 q/ha) and deltamethrin @ 15 g a.i./ha (0.15 q/ha). The lowest yield was obtained at control (0.12 q/ha). All the treatments gave significantly higher yield over control. Chlorantraniliprole @ 10 g a.i./ha registered highest cost: benefit ratio (1 : 5.01) and successfully reduced the aphid population. The LC<sub>50</sub> values of deltamethrin, imidacloprid, chlorantraniliprole, emamectin benzoate and thiamethoxam to susceptible laboratory reared AAU collected *H. armigera* were 0.0063, 0.0042, 0.0035, 0.0038 and 0.0039 per cent after 24 hrs and 0.0046, 0.0016, 0.0011, 0.0015, 0.0014 per cent after 48 hrs respectively. The residual toxicity of chlorantraniliprole @ 10 g a.i./ha in tomato to 7 days old larva of *H. armigera* was highest (85.00% and 87.50% mortality) at 24 and 48 hrs exposure period when treated terminal shoots and fruits were fed after one day of spraying while deltamethrin @ 15 g a.i./ha treated terminal shoots and fruits caused lowest larval mortality (45.00% and 50.00%). The highest PT and RPT values were observed at chlorantraniliprole @ 10 g a.i./ha (1050 and 2.18 respectively) followed by emamectin benzoate @ 11 g a.i./ha (990 and 2.06), thiamethoxam @ 26 g a.i./ha (937.50 and 1.95), imidacloprid @ 20 g a.i./ha (810 and 1.68) and deltamethrin @ 15 g a.i./ha (480 and 1.00). Considering the results of bio efficacy, relative and residual toxicity, fruit borer population reduction, yield, cost-benefit ratio, application of chlorantraniliprole @ 10 g a.i./ha can be suggested for field application for management of *H. armigera* population or can be incorporated in IPM of *H. armigera*. Moreover, these new chemicals chlorantraniliprole @ 10 g a.i./ha, emamectin benzoate @ 11 g a.i./ha and thiamethoxam @ 26 g a.i./ha can be used in rotation or combination for resistance management.

## **Migration and foraging behaviour of giant honey bee, *Apis dorsata* F. on oilseed ecosystem**

*Ningthoujam Ajitkumar Singh*

The present investigation on “Migration and foraging behaviour of giant honey bee, *Apis dorsata* F. on oilseed ecosystem” have been carried out at the Instructionalcum-Research Farm, Department of Entomology and Biochemistry and Agricultural Chemistry, Assam Agricultural University during the period 2017-2020. Immigration of *Apis dorsata* started in november and stayed stationary till July. The colonies started the emigration from May, and only a few stayed after July and none after August. The place of the nesting sites of *Apis dorsata* colonies was observed from three nesting sources viz., tree trunks (16 nos.), water tanks or towers (33.5 nos.) and roof of buildings (11.5 nos.). In June the maximum numbers of swarm migration were observed on Tree trunks (1.25 nos.), water tanks or towers (3.38 nos.) and roof of the building (0.63 nos.), respectively. The brood, pollen, honey and comb area of *Apis dorsata* were observed from the different sizes of beehives after the absconding of the bee during September/October. The brood area was founded to be maximum in the water tank or tower (1176.38 cm<sup>2</sup>) followed by the tree trunk and roof of the building (1060.88 and 872.25 cm<sup>2</sup>). A similar pattern was observed in the case of pollen, honey, and comb area and was founded maximum in the water tank or tower (1181.63, 218.88, and 2576.88 cm<sup>2</sup>) followed by a tree trunk (1021.63, 212.13, and 2294.63 cm<sup>2</sup>) and roof of the building (701.125, 172.50 and 1745.88 cm<sup>2</sup>), respectively. The study of foraging behaviour of *Apis dorsata* on rapeseed and sesamum were carried out with the treatments Open pollination (OP), Pollinator exclusion (PE), Bee pollination 1 (BP1) @ 20,000 nos. bees/ha, Bee pollination 2 (BP2) @ 30,000 nos. bees/ha, Bee pollination 3 (BP3) @ 40,000 nos. bees/ ha and Bee pollination 4 (BP4) @ 50,000 nos. bees/ha. Among the different insect foragers of rapeseed, *Apis dorsata* was the most dominant forager comprising 29.04% followed by *Apis cerana indica* (24.24%), *Apis florea* (16.24%), *Apis mellifera* (12.27%), *Xylocopa tenuiscapa* (4.24%) and other pollinators like *Cotesia glomeratus* (2.14%), *Coccinella septempunctata* (1.54%), *Pieris rapae* (1.34%), *Cycloneda sanguinea* (1.24%), *Megachile spp* (1.24%), *Episyrphus balteatus* (1.05%), *Musca domestica* (1.05%), *Harmonia axyridis* (1.04%), *Lytta stygica* (0.63%),

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*Danaus chrysippus* (0.45%), *Eupeodes corollae* (0.43%), *Papilio demoleus* (0.37%), *Camponotus sericius* (0.28%), *Cryomya bezziane* (0.22%), *Nephrotoma appendiculata* (0.17%), *Murgantia histrionica* (0.16%), *Sarcophaga peregrine* (0.14%), *Plutella xylostella* (0.12%), *Thymelicus sylvestris* (0.12%) and *Amata* spp. (0.12%), respectively. The study of the foraging behaviour of *Apis dorsata* revealed that 1000-1100 hours of the day was the maximum time spent per flower and maximum peak period (8.40 seconds). The number of flowers visits per minute was recorded to be maximum (14.60 nos./min) during 0900-1000 hours and minimum (02.10 nos./min) during 1500-1600 hours of the day. The numbers of *Apis dorsata* per square meter per minute was found to be maximum (8.50 nos.) during 0900-1000 hours and minimum (1.40 nos.) during 1500-1600 hours of the day. The seed per capsule, seed setting per cent, and yield of rapeseed were found to be higher in *Apis dorsata* pollinated treatments over OP and PE. The highest per cent of seed set was recorded in BP4 (90.67%) and the lowest was PE (46.04%). Similarly, the highest per cent seed per capsule was recorded in BP4 (20.11 nos.) and the lowest was in PE (11.80 nos.). The pooled analysis of data for both the years (2018-19 and 2019-20) revealed that the highest yield was recorded in BP4 (12.97 q/ha) and the lowest (06.01 q/ha) in PE. Among the different insect foragers of sesamum consisted a total of 14 species namely *Apis cerana indica* was the most dominant forager comprising 27.22%, followed by *Apis dorsata* (23.66%), *Apis mellifera* (14.05%), *Apis florea* (8.12%), and other pollinators like *Musca domestica* (9.37%), *Xylocopa leucothorax* (4.04%), *Cespa cincta* (3.04%), *Coccinella transversalis* (2.36%), *Chalicodoma cephalotes* (2.17%), *Pieris rapae* (1.53%), *Sarcophaga* spp. (1.4%), *Episyrphous belteatus* (1.15%), *Danaus chrysippus* (1.05%) and *Camponotus sericius* (0.79%). The maximum number of pollinators were found highest in Hymenoptera (83.09%) followed by Diptera (11.94%), Lepidoptera (2.58%) and Coleoptera (2.36%), respectively. The study of foraging behaviour of *Apis dorsata* revealed that 1000-1100 hours was the maximum time spent per flower and maximum peak period (7.10 seconds). The numbers of flowers visited per minute were recorded to be maximum (16.30 nos./min) during 1000-1100 hours and minimum (01.20 nos./min) during 1500-1600 hours of the day. The number of *Apis dorsata* per square meter per minute was recorded to be maximum (6.75 nos.) during 1100-1200 hours and the minimum was (0.25 no.) during 1500-1600 hours of the day. The seed per capsule, seed setting per cent, and yield of sesamum were found to be higher in *Apis dorsata* pollinated treatments over OP and PE. The highest per cent of seed set was recorded in BP4 (82.69%) and the lowest was PE (61.24). Similarly, the highest per cent seed per capsule was recorded in BP4 (62.58 nos.) and the lowest was in PE (53.85 nos.). The pooled analysis of data for both the years (2018-19 and 2019-20) revealed that the highest yield was recorded in BP4 (8.64 q/ha) and the lowest (05.57 q/ha) in PE. The biochemical analysis of *Apis dorsata* honeys collected from different North Eastern Region of India was analysed. The highest moisture content was recorded in honey collected from Nagaland (25.13%) and lowest (20.03%) from Sikkim and Meghalaya. The highest total soluble sugars per cent was found in Sikkim (78.33%) and lowest

(74.00%) was found in Nagaland. The highest total reducing sugars before inversion and after inversion was found in Sikkim (71.29 and 72.29 %) and lowest (63.03 and 67.58 %) was found in Tripura. The apparent sucrose content was found highest in the honey collected from Tripura (4.32%) and lowest (0.95%) from Sikkim. The fructose-glucose ratio was found to be highest in the honey collected from Meghalaya 1.44 and lowest 1.09 from Nagaland. The highest ash content of the various honey samples found in honey collected from Sikkim, Meghalaya and Mizoram (0.33%) and lowest (0.13%) was from Tripura. The highest total phenol content for the various honey collected from *Apis dorsata* 441.98 mg/100g was observed from Mizoram and lowest 247.17 mg/100g from Tripura. The highest total flavonoid content was found in Meghalaya 45.85 mg/100g and the lowest 12.98 mg/100g was found in Nagaland. The highest total carotenoid content was reported in honey collected from Mizoram 0.80 mg  $\beta$ -carotene/100g and lowest 0.10 mg  $\beta$ carotene/100g from Tripura. The highest 50% DPPH free radical scavenging activity 27.85 mg was observed from Tripura and lowest 2.12 mg was observed in Sikkim. The honey of *Apis dorsata* was found to be an important source of total phenol, total flavonoid, carotenoid and other compounds which are responsible for functional and nutraceutical properties. Its composition was extremely variable, depending on its geographical and botanical origins.



## **Evaluation of insecticidal materials against some soil insect pests of potato**

*Saurabh Sarma*

Laboratory and field experiments were carried out in the Soil Arthropod Pests Laboratory, Department of Entomology; Soil Microbiology Laboratory, Department of Soil Science; Laboratory of Integrated Farming System and Instructional Cum Research Farm of Assam Agricultural University, Jorhat during 2017-20 to evaluate the effectiveness of different insecticidal materials against some soil insect pests of potato. Fourteen (14) numbers of locally and naturally available eco-friendly insecticidal materials were collected and grouped into four groups (Group I-Physical poisons, Group II-Biopesticides and bio-enhancers, Group III-Botanicals and Group IV-Minerals) based on their different properties. Individual screening of these materials was carried out under laboratory conditions against cutworm (*Agrotis ipsilon*), white grub (*Lepidiota mansueta*) and red ant (*Dorylus orientalis*). Out of the 14 insecticidal materials tested, a total of 11 were selected based on their efficacy and finally 15 numbers of insecticidal mixtures were prepared through trial and error method. From 15 insecticidal mixtures, 5 numbers of mixtures (Mixture-II: mustard oil cake + cow urine + wood ash + neem leaf powder + saw dust; Mixture-IV: mustard oil cake + cow urine + wood ash + tobacco leaf powder + fine sand; Mixture-VIII: mustard oil cake + cow urine + wood ash + jatropa leaf powder + saw dust; Mixture-XI: mustard oil cake + cow urine + wood ash + pongamia seed powder + saw dust and Mixture-XIII: mustard oil cake + cow urine + wood ash + king chili powder + fine sand) were recorded to be superior over the other mixtures in causing mortality of *A. ipsilon* larvae, *L. mansueta* grubs and *D. orientalis*. Based on superiority, the aforementioned 5 mixtures along with two insecticidal checks (malathion 5% dust and chlorpyrifos 20 EC) were considered to investigate their possible effects on soil physico-chemical properties under laboratory conditions. Highest available N (278.2, 270.9 and 260.9 kg ha<sup>-1</sup> on 30, 60 and 90 DAT, respectively) was recorded in soil treated with Mixture-XI which was significantly superior over other mixtures except for the Mixture-II. Maximum (33.34, 33.24 and 33.16 kg ha<sup>-1</sup> on 30, 60 and 90 DAT, respectively) available P was estimated in soil treated with Mixture-II and found at par with all other mixtures except for Mixture-IV.

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Soil amended with Mixtures IV and XI registered significantly highest available K (210.61, 213.87 and 214.39 kg ha<sup>-1</sup> on 30, 60 and 90 DAT, respectively) and CEC [5.63, 5.60 and 5.58 cmol (p<sup>+</sup>) kg<sup>-1</sup> on 30, 60 and 90 DAT, respectively] as compared to the other mixtures tested. However, the pH content was varied from 5.10 to 5.17 in the soil treated with the 5 individual mixtures and found nonsignificant. Mixture-XI registered the highest (0.79, 0.72 and 0.69%) organic carbon content followed by Mixture-II (0.74, 0.69 and 0.67%) and Mixture-IV (0.71, 0.67 and 0.65%) at 30, 60 and 90 DAT, respectively. Minimum (1.31, 1.31 and 1.32 Mg cm<sup>-3</sup> on 30, 60 and 90 DAT, respectively) bulk density was recorded in soil treated with Mixture-XI which showed statistical parity with other mixtures. The Soil Microbial Biomass Carbon content was found maximum (147.6, 136.9 and 124.9  $\square$  g g<sup>-1</sup> on 30, 60 and 90 DAT, respectively) in soil treated with Mixture-XI and was found statistically at par with Mixtures II, IV and VIII, but significantly higher than Mixture-XIII. No change in the soil textural class was registered during the course of study. Activity of five key soil enzymes viz., fluorescein di-acetate hydrolysis (FDA), Dehydrogenase, Phosphomonoesterase (PMEase),  $\beta$ -glucosidase and Urease of the treated soils with the individual mixtures as well as insecticidal checks were assessed by raising French bean as the test crop. FDA activity was significantly the highest (6.51  $\mu$ g fluorescein g<sup>-1</sup> soil h<sup>-1</sup>) in the soil treated with Mixture-XI over other mixtures except Mixture-II which was found nonsignificant. Enzyme activities in respect of dehydrogenase (94.20  $\mu$ g TTF g<sup>-1</sup> soil 24 h<sup>-1</sup>), urease (119.17  $\mu$ g NH<sub>4</sub>-N g<sup>-1</sup> soil 2 h<sup>-1</sup>) and  $\beta$ -glucosidase (125.50  $\mu$ g p-nitrophenol g<sup>-1</sup> dry soil 2 h<sup>-1</sup>) were also recorded as the highest in the soils mixed with Mixture-XI and was significantly superior over rest of the mixtures. Highest PMEase activity (196.39  $\mu$ g p-nitrophenol g<sup>-1</sup> soil h<sup>-1</sup>) was observed in the soil treated with Mixture-II which showed statistical parity with Mixture-XI (189.54  $\mu$ g p-nitrophenol g<sup>-1</sup> soil h<sup>-1</sup>) but significantly superior over rest of the mixtures. As regards to per cent increase in enzymatic activities, the insecticidal Mixture-XI recorded 125.43, 169.55, 124.9, 155.49 and 200.02 per cent of FDA, dehydrogenase, PMEase,  $\beta$ -glucosidase and urease activities, respectively as compared to their initial enzymatic activity status. A declining trend of enzyme activities was observed in the soils treated with chlorpyrifos 20 EC and malathion 5 per cent dust as compared to the untreated control. Perusal of data in respect of both soil physico-chemical properties and soil enzyme activities, Mixture-XI @ 250 kg/ha was considered for field evaluation along with two insecticidal checks against various soil insect pests of potato. Experimental results indicated that all the treatments were significantly superior in suppressing infestation inflicted by various soil insect pests as compared to the untreated control. Mixture-XI recorded tuber damage (9.86 and 10.43% on weight and number basis, respectively) which was statistically at par with malathion 5 per cent dust @ 40 kg/ha (9.11 and 9.27% tuber damage on weight and number basis, respectively) but significantly higher than chlorpyrifos 20 EC @ 300 g a.i./ha (6.06 and 6.40% tuber damage, respectively). As regards to tuber yield, Mixture-XI registered 168.29 q/ha which was found to be at par with malathion 5 per cent dust (169.77 q/ha) and chlorpyrifos 20 EC (178.63 q/ha) treated plots. The

Scanning Electron Microscope (SEM) of the Mixture-XI was carried out which showed clear heterogeneous nature of the particles present in the mixture under different magnifications. Energy Dispersive X-ray (EDX) analysis revealed the presence of 2 numbers of macro elements and 7 numbers of microelements in the mixture sample. Gas Chromatography-Mass Spectrometry (GC-MS) analysis detected 12 numbers of volatile compounds having possible role in insect pests and disease management and host plants resistance.

## **Nutritional profiling of some edible orthopteran insects**

*Snigdha Bhattacharjee*

Laboratory experiments were carried out to assess the nutritive value of four edible orthopteran insect species viz., field cricket (*Brachytrupes portentosus*), mole cricket (*Gryllotalpa africana*), rice grasshopper (*Oxya* sp.) and cone headed grasshopper (*Ruspolia nitidula*) based on their proximate & elemental content, amino & fatty acid profiles, antioxidant & anti-nutritional properties as well as their microbial aspects in the Soil Arthropod Pests Laboratory, Department of Entomology; Post Graduate Laboratory, Department of Biochemistry & Agricultural Chemistry and Soil Biodiversity- Biofertilizers Laboratory, Department of Soil Science, Assam Agricultural University, Jorhat during 2017-2020. Proximate analysis of all the four edible insect species revealed that the moisture content ranged from 2.559-7.537 per cent. Perusal of data showed that the highest mean percentage of moisture content was recorded in *B. portentosus* (7.537%) whereas *R. nitidula* registered the least moisture content (2.559%) which makes the insect powder preferably suitable to be preserved for a reasonable period of time without the risk of any microbial deterioration. The carbohydrate content of the studied species varied widely and ranged from 5.138-24.219 per cent where the maximum (24.219%) was registered in *Oxya* sp. and the lowest (5.138%) was recorded in *B. portentosus*. Appreciable amount of crude protein content was estimated in all the studied species which ranged from 45.892-69.591 per cent. The highest (69.591%) crude protein was registered in *Oxya* sp. and it was found to be significantly superior over rest of the species. The protein content recorded in *G. africana*, *B. portentosus* and *R. nitidula* were 67.884, 53.096 and 45.892 per cent, respectively. Crude fat content registered in the studied species varied significantly and was ranged from 8.478-37.619 per cent. The highest (37.619%) crude fat content was recorded in *R. nitidula* followed by *B. portentosus* (25.347%) and *Oxya* sp. (10.773%) whereas *G. africana* recorded the lowest (8.478%) amount of crude fat content. The crude fibre content varied from 2.899-9.138 per cent and *Oxya* sp. registered significantly high amount of crude fibre (9.138%) content followed by *B. portentosus* (8.409%) and *G. africana* (7.553%). The highest (5.958%) ash content was recorded in *B. portentosus* which showed statistical

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**Department: Entomology**

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parity with *G. africana* (5.686%) whereas the lowest (1.642%) was recorded in case of *R. nitidula*. While analyzing the energy content (kcal/100g) of all the four species, the maximum energy content (573.371) was estimated in *R. nitidula* followed by *Oxya* sp. (472.197) and *B. portentosus* (461.059) whereas, *G. africana* recorded the lowest energy content of 374.330 kcal/100g. Altogether 8 minerals as elemental composition were estimated in all the studied species. The mineral analysis indicated that the concentration of macro elements viz., K and Ca were significantly higher (58.868 & 29.765, mg/100g, respectively) in *B. portentosus* except for Na and Mg (35.694 & 20.319 mg/100g) whereas the lowest amount (49.573, 8.188, 17.105 and 29.549 mg/100g, respectively) was recorded in *R. nitidula*. Considerable amount of four micro elements were also recorded in all the studied species. The Fe content estimated in the studied species ranged from 12.231- 53.280 mg/100g where *G. africana* registered the highest Fe content (53.280 mg/100g) which was significantly superior over rest of the species. Zn content (mg/100g) was estimated to be the highest (15.423) in *G. africana* which showed statistical parity with *B. portentosus* (15.295) whereas significantly superior over *Oxya* sp. (12.950) and *R. nitidula* (7.848). Mn and Cu content of all the species were found comparatively in trace amounts which ranged from 0.866-6.579 mg/100g and 0.566-3.348 mg/100g, respectively. Perusal of data as regards to the amino acid composition of all the four edible species indicated the availability of 18 common amino acids, out of which 8 were essential. Among all the amino acids quantified, glutamic acid was found to be the most abundant (7.87-5.14%) in all the four species. Alanine, leucine, aspartic acid and valine were the other amino acids available in appreciable amount with values ranging from 7.21-4.86, 5.11-3.89, 4.78-3.47 and 4.18-2.83 per cent, respectively. The percentage of savory amino acids (i.e. glutamate & aspartic acid) was estimated to be highest in *B. portentosus* (7.87 & 4.78%) followed by *Oxya* sp. (7.69 & 4.62%) and *G. africana* (7.28 & 3.85%), respectively. In case of sweet amino acids (i.e. alanine & glycine), the highest amount was recorded in *Oxya* sp. (7.70 & 3.93%) followed by *B. portentosus* (7.21 & 3.42%) and *G. africana* (5.90 & 3.26%), respectively. Relatively trace amount (0.69-1.14 and 0.10-0.25%) of total sulphur containing amino acids (methionine and cysteine) were quantified in all studied edible insects, respectively. The total fatty acid analysis of all the four species revealed that the highest (13.22, 25.31 and 2.47%) amount of saturated fatty acids (SFA), monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA) were recorded in *R. nitidula* followed by *B. portentosus* (9.61% SFA, 10.56 % MUFA and 8.13 % PUFA) and *G. africana* (5.45 % SFA, 7.18 % MUFA and 4.82 % PUFA). Quantification of the fatty acid profile revealed that palmitic acid was the most predominant fatty acid in all the studied species and was recorded to be highest in *R. nitidula* (11.35%) followed by *B. portentosus* (7.14%) and *G. africana* (3.60%) whereas the least (1.55%) amount was recorded in *Oxya* sp. The findings also revealed the presence of one essential omega 6 7 fatty acid i.e. linoleic acid (1.65%) in *Oxya* sp. The rest of the fatty acids were recorded in relatively trace amounts in all the studied insect species. The rest of the fatty acids were recorded in trace amount in all the studied insect species. As antioxidants, phenol and

flavonoid contents of all the studied edible insect species was estimated and the data found to be varied from 1.062-4.467 mg catechol equivalent/g and 2.412-4.470 mg quercetin equivalent/g, respectively. *Oxya* sp. registered the highest (4.467 mg catechol equivalent/g) phenol content and was found to be significantly superior over rest of the species. The highest flavonoid content (4.470 mg quercetin equivalent/g) was also registered in *Oxya* sp. followed by *B. portentosus* (3.071 mg quercetin equivalent/g) and *G. africana* (2.799 mg quercetin equivalent/g). Tannin, phytic acid and oxalic acid contents were also estimated as antinutritional factors and were recorded within the permissible limit (250-500 mg/100g). The concentration of phytic acid and tannin were ranged from 26.620-122.427 mg/100g and 97.823-210.500 mg tannic acid equivalent/100g, respectively. The oxalic acid recorded in case of *B. portentosus*, *G. africana*, *Oxya* sp. and *R. nitidula* were 3.542, 2.910, 3.530 and 3.795 mg/100g, respectively. Investigations on the microbial aspects of insect powders revealed that the Total Viable Counts (TVC) were higher in the samples stored under ambient temperature (9.06-9.29 log cfu/g) as compared to the samples stored under refrigerated temperature (7.33-7.66 log cfu/g). Perusal of data showed that the obtained values exceeded the guideline values for minced meat (i.e. between 5.7-6.7 log cfu/g), however, microbial enumerations of powdered insect samples after 15 days of storage showed that all the samples were free of any yeast and mould contaminations. Biochemical test kits further confirmed the absence of two common food borne pathogens i.e. *Escherichia coli* and *Salmonella* sp. in all the studied insect samples.

## **Toxicological studies of certain insecticides on Brinjal Shoot and Fruit Borer, *Leucinodes orbonalis* (Guenee) (Pyraustidae:Lepidoptera)**

*Sushmita Thokchom*

Brinjal (*Solanum melongena* L.) is a Solanaceous, most dominant vegetable crop grown throughout the world. Brinjal contains some essential biochemical and minerals like vitamins, calcium, protein and phosphorus. The present experiment on 'Toxicological studies of certain insecticides on Brinjal Shoot and Fruit Borer, *Leucinodes orbonalis* (Guenee) (Pyraustidae: Lepidoptera)' was carried out to evaluate the bioefficacy, relative toxicity and residual effect of five commonly used insecticides on brinjal against *Leucinodes orbonalis* (Guenee). The insecticides were chlorantraniliprole 18.5 SC (Coragen), thiamethoxam 25 WG (Actara) and lambda cyhalothrin 4.9 CS (Karate), Dimethoate 30 EC (Tafgor) and Malathion 50 EC (Cythion). Among all the insecticides chlorantraniliprole 18.5 SC (Coragen) was found to be the most toxic showing LC50 0.031% at 24 hours and 0.010% at 48 hours. The study of bio-efficacy showed that chlorantraniliprole 18.5 SC @40 ga.i/ha was found to be the most effective insecticide for controlling infested shoot and infested fruit, quality parameters and yield of the fruit. Chlorantraniliprole 18.50 SC @ 40 g a.i/ha recorded least number of infested shoot with 0.25 number and 90.56 per cent reduction of infested shoot and also minimum number of infested fruit with 0.20 number and reduction of (91.30%) at 10 DAS during Kharif, 2019. Similar results were also observed during Rabi, 2018 in case of number of infested fruit and infested shoot. The lowest number of infested shoot was registered in chlorantraniliprole 18.50 SC @ 40 g a.i/ha which recorded 0.35 number and 87.27 percent reduction of infested shoot which was significantly lower than the other insecticides after 10 DAS. The highest reduction of infested fruits (89.36%) was also observed in chlorantraniliprole 18.50 SC @ 40 g a.i/ha with 0.25 number. The fruit length for both Rabi, 2018 and Kharif, 2019 was found to be significantly highest in plot treated with chlorantraniliprole 18.50 SC @ 40 g a.i/ha showing (17.75±0.45 cm and 17.50± 0.21 cm). In both rabi 2018 and kharif 2019 season, fruit diameter was observed (2.75±0.32 cm and 2.87±0.40 cm) in

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chlorantraniliprole 18.50 SC @ 40 ga.i/ha and the mean fruit diameter was found to be non-significant within the insecticidal treatments. The mean fruit weight for both rabi, 2018 and kharif, 2019 was found to be highest in plot treated with chlorantraniliprole 18.50 SC @ 40 g a.i/ha which recorded (16.00±0.24 gm and 16.25±0.40 gm). The yield obtained (q/ha) during the rabi, 2018 and kharif, 2019 was highest in chlorantraniliprole 18.50 SC @ 40 g a.i/ha which differed significantly from other treatments which recorded 40.33 q/ha and 40.13 q/ha respectively. Among the treatments, the highest benefit was obtained from the treatment of chlorantraniliprole 18.50 SC @ 40 g a.i/ha with a cost- benefit ratio of 1: 5.63 during 2018-2019. The study of succession showed that six insect pests were observed during different stages of the crop along with fifteen natural enemies in brinjal ecosystem from October, 2018 to July, 2019. The highest per cent relative abundance was observed in case of aphid (27.70%) followed by shoot and fruit borer (22.22%). Among the natural enemies, the order coleoptera is the most dominant order which recorded (57%) followed by araneae (29%) and the highest relative abundance per cent was observed in both *Brumoides saturalis* and *Micraspis discolor* (17.06%) followed by *Cheilomenus sexmaculatus* and *Coccinella transversalis* (13.65%). Residual analysis of three insecticides on brinjal was evaluated viz., chlorantraniliprole, thiamethoxam and lambda cyhalothrin. For quantification of chlorantraniliprole, the detection at 225 nm gave satisfactory chromatograms with a retention factor of 5.3 min. Similarly, for quantification of thiamethoxam and lambda cyhalothrin, the detection was found at 230 nm which was similar with a retention factor of 4.5 min and the later 4.3 min. The mean percent recoveries of chlorantraniliprole, thiamethoxam and lambda cyhalothrin at the spiked level of 0.10, 0.25, 0.50 and 1.00 mg/kg were found to be in the range of (83.67% to 96.67%) for chlorantraniliprole, (86.33% to 94.00%) for thiamethoxam and (81.67% to 98.00%) for lambda cyhalothrin. Thiamethoxam residues were found to be maximum which is 0.78 mg/kg collected at 0 day (1hr after spraying) after the first application of thiamethoxam @50 g a.i/ha. After 9 days, it became to 100 per cent which shows no detection of residue. The residues of thiamethoxam washed with normal water were found to be 0.43 mg/kg. It became 100 per cent after 9 days of thiamethoxam washed with normal water. Likewise, the residues of thiamethoxam treated with warm (2%) brine solution was found to be 0.35 mg/kg which is less as compared to thiamethoxam application and thiamethoxam sample washed with normal water after 0 day (1hr after spraying). The maximum residues of chlorantraniliprole were appeared to be 0.51 mg/kg in brinjal sample collected at 0 day (1hr after spraying) after first application of chlorantraniliprole @40 g a. i./ ha. After 9 days, it became to 100 per cent. The residues of chlorantraniliprole washed with normal water at 0 day (1hr after application) was found to be 0.46 mg/kg. No detection of residues was observed after 9 days of treatment. Additionally, the maximum residue was observed to be 0.33 mg/kg at 0 day (1 hr after spraying) in the brinjal sample treated with warm (2%) brine solution. After 7 days, it rises to 100 per cent which shows that there is no residue of chlorantraniliprole. The residues in brinjal sample at 0 day (1 hr after spraying) after first application of lambda cyhalothrin @ 15 g a.i/ha were observed



to be 0.31 mg/kg. Finally, it attained to 100 per cent after 9 days. The residues of lambda cyhalothrin washed with normal water at 0 day (1hr after application) was found to be 0.23 mg/kg which has reached to the below determination limit of 0.01 mg/kg which dissipated after 7 days and reached 100 per cent. The (2%) brine solution helped in the removal of pesticide residues in brinjal sample. The residue was found to be 0.20 mg/kg at 0 day (1 hr after spraying). After 7 days, the residue was not traceable which has reached to the below determination limit of 0.01 mg/kg which attained 100 per cent. Half-life (T<sub>1/2</sub>) of chlorantraniliprole sample was found to be 1.51 days when applied @ 40 g a.i/ ha. For chlorantraniliprole sample washed with normal water, the half-life (T<sub>1/2</sub>) was shown to be 1.43 days. Half-life (T<sub>1/2</sub>) of chlorantraniliprole sample treated with 2% brine solution was found to be 1.30 days. Half-life (T<sub>1/2</sub>) of thiamethoxam sample was observed to be 1.84 days when applied @ 50 g a.i/ha. Whereas half-life (T<sub>1/2</sub>) of thiamethoxam sample washed with normal water was noticed to be 1.40 days. For thiamethoxam sample treated with (2%) brine solution the half-life (T<sub>1/2</sub>) was observed to be 1.30 days. Half-life (T<sub>1/2</sub>) of lambda cyhalothrin sample was seen to be 1.48 days when applied @ 15 g a.i/ha. Additionally, half- life (T<sub>1/2</sub>) of lambda cyhalothrin sample washed with normal water was found to be 1.06 days. For lambda cyhalothrin sample treated with (2%) brine solution the half-life (T<sub>1/2</sub>) was observed to be 1.02 days. Tsi (Safety interval) of chlorantraniliprole sample was found to be 6.18 days when applied @40 g a.i/ ha. For chlorantraniliprole sample washed with normal water, the Tsi was shown to be 5.80 days. Tsi of chlorantraniliprole sample treated with (2%) brine solution was found to be 5.29 days. Tsi of thiamethoxam sample was observed to be 1.33 days when applied @ 50 g a.i/ha. Whereas Tsi of thiamethoxam sample washed with normal water was noticed to be 1.01 days. For thiamethoxam sample treated with (2%) brine solution the Tsi was observed to be 0.94 days. Tsi of lambda cyhalothrin sample was seen to be 1.91 days when applied @ 15 g a.i/ha. Additionally, Tsi of lambda cyhalothrin sample washed with normal water was found to be 1.37 days. For lambda cyhalothrin sample treated with (2%) brine solution the Tsi was observed to be 1.32 days. Based on yield, reduction of infested shoots and fruits number, residues, dissipation pattern, half-life, waiting period and MRL (0.03 mg/kg) and (0.2 mg/kg) of chlorantraniliprole 18.50 SC @ 40 g a.i/ha or lambda cyhalothrin 4.9 CS @ 15 g a.i/ha can be suggested as sufficient treatment to optimize the yield of brinjal without harming the consumers.

## **Genetics of brinjal (*Solanum melongena* L) for adaptation in summer season**

*Bendangla Imsong*

The present investigation was carried out using twenty three genotypes of brinjal collected from Horticultural Research Station, Kahikuchi, Department of Horticulture, AAU, Jorhat, Tezpur and Mizoram. The experiment was conducted at Horticulture Research Farm, Assam Agricultural University, Jorhat. In the first growing season, the twenty three genotypes were assessed and based on the performance of genotypes and initial plant data, eight lines and three testers were selected and crossed in line x tester mating design to obtain twenty four cross combinations. The parental lines, their cross combinations and a check variety was sown in the second season. The analyses of variance revealed significant variation at genotypic level among the twenty three genotypes for all the sixteen characters except one i.e, fruit length. Between the replication, it was observed that there was significant variation in respect of leaf blade length. The characters, plant spread, fruit circumference, number of fruits per plant, fruit weight, fruit volume and fruit yield per plant had high estimates of both GCV and PCV. High heritability coupled with high genetic advance was observed for the traits, plant spread, fruit circumference, number of fruits per plant, fruit weight, fruit volume and fruit yield per plant. The fruit yield per plant had a significant positive genotypic and phenotypic correlation with plant height, plant spread, number of primary branches per plant, leaf blade length, fruit pedicel length, fruit circumference, number of fruits per plant and fruit weight. There were characters which manifested to be negatively correlated with yield indicating which were days to first flowering, days to 50% flowering, days to first fruiting and days to 50% fruiting. The highest positive direct effect was of days to first flowering (6.064). The genotypic residual effect was observed to be 0.122. The twenty three genotypes were grouped into 5 clusters with cluster I having the maximum number with twelve genotypes. Cluster IV that the highest intra cluster and the inter cluster D2 value was observed to be maximum between cluster III and cluster IV. The highest contribution per cent was manifested for days to 50% flowering. The qualitative characters studied in total were fourteen. From the analysis of variance for line x tester mating design, it was found that the parents, crosses and parents vs crosses exhibited highly significant difference. The analysis of 58 variance of

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combining ability showed significant difference for the lines, tester and line x tester interaction. Except for the character, plant height, all the other characters exhibited significant difference for line x tester interaction. The estimates of SCA variance were higher than GCA variance which resulted in ratio of  $\sigma^2_{GCA}$  to  $\sigma^2_{SCA}$  less than one. The proportional contribution of line x tester interaction to total variance was more than the lines and testers. The proportional contribution of lines to total variance was more than testers and line x tester interaction in respect of fruit length and total phenol. Amongst parents, the line Longai Purple Long was observed to be the highest yielder, desirable lowest content of solasodine and exhibited earliness in days to first flowering, days to 50% flowering, days to first fruiting and days to 50% fruiting whereas the tester, KB4 manifested desirable mean for eleven characters which were leaf blade length, days to first flowering, days to 50% flowering, days to first fruiting, days to 50% fruiting, fruit length, fruit weight, fruit volume, fruit yield per plant, phenol content and crude protein. The cross Green Streaked x Balijana showed desirable mean for six traits among all the crosses which were leaf blade width, days to first flowering, days to 50% flowering, days to first fruiting, days to 50% fruiting and solasodine content. The highest yielder was M2 x KB4 among all the twenty four crosses. In regard to good general combining ability of the parents, the line Longai Long was observed to exhibit both positive and negative effects in desired direction for eleven traits. The lines found to be good general combiners for yield were Longai Purple Oblong and Barpeta and for earliness besides Long Long. The cross, HRS4 x Balijana was found to have the maximum number of positive and negative sca effects in favourable trend. The hybrid M2 x KB4 manifested highest average heterosis for fruit yield per plant followed by Longai Long x KB4 and HRS4 x Balijana. The cross M2 x KB4 produced the highest yield.

# **A mixed-method analysis on effectiveness of information flow mechanism among the stakeholders of Post T&V system and ATMA model in Assam**

*Dipanjali Saikia*

Access to knowledge and information has become an instrumental component to society's progress. Information utilization in agriculture has played a key role in boosting agricultural productivity and in overall progress of the farm sector. If properly utilized, information can help in improvement of the farm household economy. The sources of information utilized may however vary. The suitability of these sources utilized also varies according to their needs and the situation they are in. The Indian public agricultural extension system has been a world leader in knowledge and information dissemination. Extension workers and researchers work together to improve farmer productivity and profitability through technology transfer, it is necessary to know the information sources consulted and used by the public extension system and farmers in various situations and times to develop an effective extension system. The present study was carried out in the Lakhimpur district of Assam to discover the information flow mechanism among public extension stakeholders (ATMA model and Post T&V phase). Multi-stage sampling design was followed to select farmers and other stakeholders of the ATMA model and Post T&V system; a cent percentage population was taken for the study. A set of structured schedules was used to collect data. For the analysis, the data were grouped into frequency distributions. They paired t-tests using Karl Pearson's coefficient of correlation and Fisher's exact test. The mean age of the agricultural scientists was 40.67 years and they had attained postgraduate degrees in their field. Most agricultural scientists (83.33%) had medium service experience (6-11 years). It was also found that 50.00 per cent of the agricultural scientists attended two training sessions last year. The agricultural scientists can use mobile telephony, printing, typing, photocopying, projector, exhibition, computer, internet, periodicals and transportation for updating their knowledge. To transfer agricultural information, 33.33 per cent of agricultural scientists used low, medium, or high communication methods. The mean age of the extension personnel were 42.12 years. While 39.39 per cent of

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extension personnel had completed high school, 27.27 per cent had attained education up to graduation level (agriculture), 25.76 per cent had completed post-graduation (agriculture) and only 7.58 had completed graduation (non-agriculture). It was also found that 78.79 per cent of extension workers were men, and 21.11 per cent women. Majority (81.82%) of extension workers were from rural areas. Majority of (65.15%) of extension personnel had a medium aspirational level and 96.97 per cent had a medium service length. The study also revealed that last year, 54.54 per cent of extension personnel received medium training, in comparison, 22.73 per cent received low and 22.73 per cent received high training. 86.36 per cent of extension personnel had medium level facilities to transfer agricultural technologies, while 13.64 per cent had high-level facilities. The study also revealed that of all extension personnel, 72.73 per cent used medium communication methods, 16.67 per cent used low communication methods, and 10.60 per cent used high communication methods to transfer information. The average age of farmers was 43.43 years old, with 49.05 per cent of them having attained secondary education. 87.04 per cent of the farmers were men. Farmers owned an average land holding of 1.137 ha. About 90 per cent of farmers had a medium annual income. It was also found that 77.73 per cent of farmers were members of one single organisation. The majority of farmers were cosmopolite, and 61.54 per cent can be categorized as innovative. 68.42 per cent of farmers preferred medium risk, 62.75 per cent of farmers preferred medium media exposure and 71.66 per cent of farmers preferred medium scientific orientation. The marketing personnel had an average age of 43.36 years and 45.46 per cent had graduated from college, followed by graduate school (36.36%) and high school (18.18%). It was observed that 100 per cent of marketing personnel were men from rural backgrounds. They had an average service experience of 10.27 years and majority (54.55%) of them received no training last year. The majority of marketing personnel (55.54 %) belonged to one organization. The linkage effectiveness between research and extension was found to be 71.97 per cent, and that of between research and farmers was at 51.97 per cent. While the linkage effectiveness between extension and farmers was found to be higher (79.43%), no linkage could be found between extension and market. In the ATMA model the linkage between farmers and market the linkage effectiveness score was 14.53 per cent, in the Post T&V system, linkage between research and extension, the linkage effectiveness score was 53.83 per cent, linkage between research (KVK Scientist) and farmers, the linkage effectiveness score was 51.91 per cent, the linkage between research (KVK Scientist) and market, the linkage effectiveness score was nil (0.00%), the linkage between extension and farmers, the linkage effectiveness score was 64.32 per cent, the linkage between extension and market, the linkage effectiveness score was 8.40 per cent and the linkage between farmers and market, the linkage effectiveness score was 14.53 per cent. The study also found no significant differences in the linkage effectiveness mean score between the two systems. The study found that 63.64 per cent of agricultural scientists used agricultural information sources only moderately. The study also revealed that textbooks and the internet were more commonly used than other information sources. Majority (69.70%)

of extension personnel used agricultural information sources moderately. Among the most common personal information sources used by the extension personnel were colleagues, followed by mobile phones, senior extension officers, agricultural scientists, friends, progressive farmers, farmers committee and local leaders. Training was the most frequently used source of agricultural information for extension personnel, followed by group discussion, meeting, and tour. Agricultural literature was the most frequently used source of information by extension personnel. Majority (70.04%) of farmers also were found to be using agricultural information sources moderately. Progressive farmers were the most frequently used informal source of information for them, followed by neighbours, family members, friends/relatives and local leaders. The most useful source of formal agricultural information sources to farmers were ATMA personnel, followed by ADO, AEA, KVK, input dealers and marketing officials. The majority of farmers were found to be using the internet, followed by mobile phones, TV, newspaper, radio, agricultural literature and demonstrations for information. Among all the agricultural information sources available to marketing people, the most commonly used sources were internal, salesman, and internet, followed by colleagues, periodicals, dealers, newspaper, published market surveys, Govt. publications & reports and senior management.

## **Promotion of Agriculture Centric Sustainable Livelihood Security for Tribal Farmers of Assam**

*Haridra Sharma*

The Assam Agricultural University launched the project “Promotion of Agriculture Centric Sustainable Livelihood Security for Tribal Farmers of Assam” during 2013-14. The present study entitled ‘An appraisal of the extension programmes implemented under the project “Promotion of Agriculture Centric Sustainable Livelihood Security for Tribal Farmers of Assam” by Assam Agricultural University’ was conducted to find out whether the project was truly achieving its objectives. The study was conducted in four tribal dominated districts of Assam viz., Chirang, Kokrajhar, Dhemaji and Karbi Anglong. A purposive cum proportionate random sampling method was followed for the study. The total sample size was 400 consisting of 200 beneficiary and 200 non-beneficiary tribal farmers in the study area. For the present study, 16 independent variables, 3 dependent variables and 2 inhibitive variables were selected. Both qualitative and quantitative data were collected. Appropriate statistical techniques was used for analysis of data. Study revealed that Front Line Demonstrations (FLDs), trainings and other extension activities like field days, exposure visits, animal health camps were conducted under the project benefitting tribal farmers of the respective districts. A total of 8196 numbers of FLDs were conducted covering 8082 numbers of tribal households. A total of 136 skill trainings on different topics related to FLDs were also conducted covering 4557 numbers of tribal farmers. Again 36 numbers of extension activities were conducted including 2885 numbers of tribal farmers in the study area. The distribution of beneficiary households on Livelihood Security Index (LSI) revealed that before availing the assistance from the project, Livelihood Security Index was 0.37, which became 0.68 with a significant shift of 31.00 per cent after getting assistance from the project. Among seven components of Livelihood Security Index (LSI), a significant shift of 68.00 per cent was observed in Occupational /financial security after becoming beneficiary of the project among the tribal respondents. Second highest shift was seen in Social security with a significant shift of 63.00 per cent from 11.00 per cent before participating as a beneficiary of the project. In case of Environment Security, a significant shift of 23.00 per cent indicating

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**Major Adviser: Dr. P. Mishra**

a positive impact of the project was seen. Before getting assistance from the project for crop production and animal rearing, Food security index was 0.53, which became 0.65 after getting associated with the project as beneficiary. Habitat security shown a significant shift of 7.00 per cent on after situation than before. Data revealed a significant shift of 14.00 per cent in Educational security. Health security of the beneficiary tribal households showed a positive shift of 10.00 per cent from score 0.55 on before to 0.65 after situation. Livelihood Endowment Status (LES) was assessed comparing the beneficiary tribal farmers with non-beneficiary tribal farmers in the study areas. The distribution of beneficiary households on LES revealed that 59.00 per cent of tribal household under each component attained a high level of Endowment Status compared to non-beneficiary (33.00%) respondents. Data reveals that there was a difference of 26.00 per cent in overall Livelihood Endowment Status (LES) between two groups in the study areas. Significant difference (24.00%) was seen between beneficiary and non-beneficiary group of respondents in Natural capital formation. Physical capital formation shown a significant difference (7.00 %) between beneficiary and non-beneficiary group of respondents with mean LES score 0.51 and 0.44, respectively. Regarding Financial capital, the beneficiary group of respondents were found to have a mean score of 0.67 compared to non-beneficiary tribal farmers with a mean score of 0.31. The difference between beneficiary and non-beneficiary group of respondents was 36.00 per cent. Human capital was found to be 0.67 for non-beneficiary and 0.86 for beneficiary tribal farmers with a significant difference of 19.00 per cent. Social Capital formation was also on higher side in case of beneficiary tribal farmers (LES=0.65) compared to non-beneficiary tribal farmers (LES= 0.34). Political capital was found very low in case of non-beneficiary farmers (LES=0.02) indicating negligible participation of non-beneficiary farmers in any project meant for tribal agricultural development. Whereas, in case of beneficiary farmers, the index was 0.41 indicating comparatively good status of participation in project planning, implementation and monitoring-evaluation. Variables Annual income( $r=0.458$ ), Farm power ( $r=0.312$ ), Social participation( $r=0.438$ ), Extension agency contact (KVK) ( $r=0.763$ ), Mass media exposure ( $r=0.246$ ) and Availability of irrigation facility ( $r=0.336$ ) had positive and significant relationship with livelihood security of the beneficiary tribal farmers under study. Whereas, Distance of homestead to all weather road ( $r= -0.442$ ) was found to have negative and significant relationship with livelihood security of the tribal farmers benefitted by the project. Again, variables Education ( $r=0.121$ ), Occupation ( $r=0.195$ ), Farm power ( $r=0.348$ ), Social participation ( $r=0.520$ ), Extension agency contact (KVK) ( $r=0.718$ ) and Availability of irrigation facility ( $r=0.407$ ) were positively and significantly related towards Livelihood Endowment Status (LES). Whereas, Experiences in farming ( $r= -0.144$ ), Distance of homestead from the market ( $r= -0.049$ ) and Distance of homestead to all weather road ( $r= -0.357$ ) were found to have negative and significant relationship with Livelihood Endowment Status (LES). Comparison of profitability between beneficiary and non-beneficiary tribal farmers for paddy showed that beneficiary tribal farmers produced HYV paddy with a CBR of 1.33 compared to



non-beneficiary farmers producing local paddy varieties with CBR 0.93. The Gross Margin (GM) and Net Return (NR) were Rs. 26675.63 and Rs. 21313.13 per hectare, respectively, for beneficiary tribal farmers compared to negative values for non-beneficiary tribal farmers growing local varieties (GM= Rs. -5913.75 per hectare and NR=Rs-11276.25 per hectare). Average Rate of Return (ARR) value for beneficiary group of respondents was found to be 31.25 which was also found to have negative value for non-beneficiary tribal group of respondents (ARR= - 6.90). Productivity of paddy by beneficiary tribal farmers was higher than the non-beneficiary farmers with an incremental grain yield of 15.97 quintals per hectare and straw yield of 10.95 q per hectare. Further, data revealed that all the factors of production were not efficiently utilized by both the beneficiary and non-beneficiary group of respondents in paddy production. In case of paddy production, the seed (beneficiary R = 0.009; non-beneficiary R =0.007), human labour (beneficiary R = 0.008; non-beneficiary R = 0.010), bullock labour (beneficiary R = -0.060 ; non-beneficiary R = -0.103 ), fertilizer(beneficiary R =0.133 ; non-beneficiary R =0.028 ), manure(beneficiary R =-0.207; non-beneficiary R =-0.271) and plant protection (beneficiary R = -0.015 ; non-beneficiary R = -0.032 ) costs were over utilized as MVP < 1, in case of both beneficiary and non-beneficiary group of respondents. Whereas, tractor cost (beneficiary R = 1.197; non-beneficiary R = 1.337) was underutilized as MVP > 1 for HYV and local paddy production by both the group. In case of toria production, comparison of profitability between beneficiary and non-beneficiary tribal farmers showed that beneficiary tribal farmers produced HYV toria with a CBR of 1.35 compared to non-beneficiary farmers producing local toria varieties with CBR 0.85. The Gross Margin(GM) and Net Return(NR) were Rs. 10567.50 and Rs. 5205.00 per hectare, respectively, for beneficiary tribal farmers compared to negative values for non-beneficiary tribal farmers growing local varieties (GM= Rs. -4346.25 per ha and NR=Rs. -1294.50 per ha). Average Rate of Return (ARR) value for beneficiary group of respondents was found to be 29.78, which was also found to have negative value for non-beneficiary tribal group of respondents (ARR= -12.84). The productivity of toria had increased with an incremental yield of 4.73 q per hectare grown by beneficiary tribal farmers compared to toria grown by non-beneficiary tribal farmers. Further, data revealed that all of factors of production were not efficiently utilized by both the beneficiary and non-beneficiary group of respondents in toria production. For toria production, the seed (beneficiary R= 0.274; non-beneficiary R =0.274), human labour (beneficiary R=0.099 ; non-beneficiary R =0.099), bullock labour (beneficiary R=0.148 ; non-beneficiary R =0.148) , tractor (beneficiary R=0.434 ; non-beneficiary R =0.434), fertilizer (beneficiary R=0.317; non-beneficiary R =0.317), manure (beneficiary R=-0.112 ; non-beneficiary R =-0.112) , borax (beneficiary R= 0.255; non-beneficiary R =0.255) and plant protection (beneficiary R=0.021 ; non-beneficiary R =0.021) costs were over utilized as MVP < 1, in case of both beneficiary and non-beneficiary group of respondents. In case of piggery, comparison of profitability between beneficiary and non-beneficiary tribal farmers revealed that beneficiary tribal farmers produced improved pig breed with a CBR of

4.04 compared to non-beneficiary farmers producing local pig with CBR 2.70. The Gross Margin (GM) and Net Return (NR) were Rs. 80106.00 and Rs. 79106.00 per unit, respectively, for beneficiary tribal farmers rearing improved pig breeds compared to non-beneficiary tribal farmers rearing local breeds (GM= Rs. 29764.00 per unit and NR=Rs. 28764.00 per unit). Average Rate of Return (ARR) value for beneficiary group of respondents was found to be 293.28 which was almost double than the non-beneficiary tribal group of respondents (ARR= 160.99). In case of beneficiary tribal farmers, the piglet and body weight gained compared to local pigs were higher with positive significant difference of 7 numbers piglets /annum and 46 kg/ animal. Further, data revealed that all of factors of production were not efficiently utilized by both the beneficiary and non-beneficiary group of respondents in pig rearing. In case of beneficiary tribal farmers rearing improved pig breeds with scientific interventions, the feed (R= 0.111), medicine (R= -0.067) and labour costs (R=-0.310 ) were over utilized as MVP < 1. Whereas, piglet cost (R= 1.090) was underutilized as MVP > 1 for improved pig production. In case of non-beneficiary tribal farmers, the piglet (R=0.218), medicine (R=-0.017) and labour costs (R=0.021) were over utilized as MVP < 1. While, feed cost (R=1.042) was underutilized as MVP > 1 for local pig production. Like wise, comparison of profitability between beneficiary and non-beneficiary tribal farmers in case of poultry, showed that beneficiary tribal farmers produced dual purpose poultry breed Vanaraja with a CBR of 2.59 compared non-beneficiary farmers producing local poultry with CBR 1.56. The Gross Margin (GM) and Net Return (NR) were Rs. 9610.00 and Rs. 9110.00 per unit, respectively, for beneficiary tribal farmers compared to low values for non-beneficiary tribal farmers rearing local breeds (GM= Rs. 2528.00 and NR=2028.00 per unit). Average Rate of Return (ARR) value for beneficiary group of respondents was found to be 147.00 which was almost triple than non-beneficiary tribal group of respondents(ARR= 50.40). In case of beneficiary tribal farmers, the egg production and body weight gained compared to local poultry was higher with positive significant difference of 78 numbers eggs/hen and 1.21 kg/ live bird. Further, data revealed that all of factors of production were not efficiently utilized by both the beneficiary and non-beneficiary group of respondents in poultry rearing. In case of beneficiary tribal farmers rearing dual purpose poultry breed Vanaraja with scientific interventions, the DOC (R= 0.165), feed(R=-0.109 ), medicine (R= 0.049) and labour (R=-0.041 ) costs were over utilized as MVP < 1. Whereas, stock size (R= 3.465) was underutilized as MVP > 1 for dual purpose poultry production. In case of non-beneficiary tribal farmers, the DOC (R= 0.316), feed(R=-0.206 ), medicine(R= 0.095) and labour (R= 0.000) costs were over utilized as MVP < 1. While, stock size (R= 3.609) was underutilized as MVP > 1 for local poultry production. The major constraints faced by the project staff during implementation of the project were –excessive dependency of the tribal farmers on free aid from project (100.00%), no habit of savings and investment for next season by the tribal farmers (90.90%), implementation during large scale demonstration suffered due to small land holdings in different tribal villages (63.64%), lack of interest of tribal farmers on planting material/ seed/piglet/chicks

production (63.64%), shortage of quality planting materials (especially fruits), improved breeds of livestock (Pig, Goat, Poultry etc.) and quality fingerlings in the state (63.64%), less responsiveness of the tribal farmers towards to demonstrated technologies (63.64%), varied response and level of adoption among different tribal communities (54.55%), lack of effective market linkage approach affecting tribal farmers with better farm production (54.55%), lack of farmer's organization at village level creates problem during implementation of programmes like establishment of Custom Hiring Centers (54.55%), shortage of support from health workers in animal health (livestock) sector in remote tribal villages (54.55%), lack of awareness among the farmers regarding developmental projects operating under participatory mode like project under TSP (45.45%), poor coordination among line departments in implementation of the TSP project on sericulture, agroforestry, farming system, etc. (18.18%) and varied response in implementation of the project among the scientists of cooperating centers within AAU(18.18%). The major constraints faced by the project staff during monitoring of the project were- limited manpower at KVK/Research stations to look after numbers of activities at the same time (54.55%) and difficulties faced to follow the designed Detailed Project Report (DPR) all the time due to maintenance of official formalities (9.09%). Major constraints faced by beneficiary tribal farmers in implementation and adoption of recommended practices were- input supply was not timely for most of the cases (99.00%), non-availability of suggested inputs e.g. varieties/ breeds locally after project period (98.50%), dominance by few local individuals (98.00%), lack of irrigation facilities (97.50%), high cost of inputs like feed for animal and birds (95.00%), lack of own capital (90.00%), difficulty in maintaining accounts (90.00%), comparatively less market demand for poultry/ pig breed given by the project side due to size and meat quality (75.00%), less technical assistance after the project period (72.50%), no store keeper in Custom Hiring Centres hence not safe to store produces (67.50%), excessive formalities for institutional credit facilities (63.00%), machineries with low capacity in Custom Hiring Centres (62.50%), low return from agricultural enterprises (49.00 %), frequent transfer of the scientific staff from KVK/RARS (48.50%) and conflict during decision making in groups (42.00%). Thus, it is concluded that strategies need to be formulated for further refinement of projects aimed at tribal agriculture development in the study areas.

# **Evaluation of Small and Marginal Farmers' Livelihood Strategies, Changing Trends and Preferences for Income Generating Activities for Future in Assam**

*Pallabi Phukan*

Rural livelihood in India is complex, involving multiple activities and strategies. Agriculture is an integral part of daily life on the Indian subcontinent, with 82 per cent of farmers being small. Despite occupying only 44% of arable land, small farms are the country's primary food and nutritional security providers. Even so, they lack access to markets and technology. Small and marginal families are contributing more to the national food supply and agricultural GDP; they account for more than half of the hungry and poor. Small and marginal farmers lack access to capital and inputs. This has hampered their competitiveness in both domestic and international markets. The high-value segment of the agricultural sector is expected to benefit smallholders more than cereals because it requires more labour and yields more than cereals. Assam's agriculture is a mix of peasant and tenant farming, with most farmers being marginal (62.2%) or small (20.9%). Various economic factors (e.g., fragmented land) contribute to the state's lagging agricultural sector. Small and marginal farmers earn between Rs. 35,000/- and 40,000/- per year. Many farmers in Assam lacked collateral due to a lack of proper land inheritance documentation and inadequate land (due to land fragmentation). Already Assamese farmers are reluctant to adopt farming as a source of livelihood for small and marginal farmers. Rural youth are no longer interested in farming as a source of livelihood. In reality, most farmers in Assam own less than two acres of land. Therefore, the present study has been proposed to be undertaken to find out the small and marginal farmers' livelihood options and perceived profitable agricultural activities in future; thereby, one can prepare the right strategy to strengthen the livelihood of small and marginal farmers with following objectives:

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**Abstract of Ph. D. thesis**

**Department: Extension Education**

**Major Adviser: Dr. Utpal Barman**

# **Adoption of tea cultivation practices by trained and untrained small tea growers- An evaluative study in Upper Brahmaputra Valley Zone of Assam**

*Purnima Saikia*

The study entitled “Adoption of tea cultivation practices by trained and untrained small tea growers- An evaluative study in Upper Brahmaputra Valley Zone of Assam” was carried out during 2020-21. Multistage purposive cum random sampling design was used for selection of respondents. A total of 400 (200 trained and 200 untrained) respondents constituted the sample of the study. Data collection was done by adopting the personal interview technique administering a structured schedule. Frequency, percentage, mean, standard deviation, coefficient of variation, ‘t’ test, weighted mean score, rank analysis, two sample ‘t’ test for comparing two means, correlation and multiple regression were the statistical techniques used for the analysis of data. The study revealed that majority of the trained respondents (50.00%) were belonged to young age group. On the other hand majority of the untrained respondents (49.50%) were belonged to young age group. Majority of the trained respondents (25.00%) and untrained respondents (26.50%) were middle school level and primary school level, respectively. Moreover, majority of the trained respondents (78.50%) and untrained respondents (73.50%) had nuclear type of family. In case of operational land holding, majority of the trained respondents (52.00%) and untrained respondents (58.50%) were small farmers. It was found that majority of the trained (55.00%) and untrained (59.00%) respondents had medium level of annual income. It was observed that majority of the trained respondents (54.50%) and untrained respondents (63.00%) had only cultivation as occupation. In case of experience of tea growers 58.50 per cent of the trained respondents and 57.50 per cent of the untrained respondents had average experience (5-10 years). It was found that majority (40.50%) of the respondents had attended 2 days training programme. Majority of the trained (67.50%) and untrained (76.50%) respondents had medium level of mass media exposure. It was also observed that majority of the trained (60.50%) and untrained (72.00%) respondents had medium

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level of extension contact. Majority of the trained (77.00%) and untrained (90.50%) respondents had medium level of social participation. Majority (57.50%) and (57.00%) of the trained and untrained small tea growers possessed medium level of achievement motivation, respectively. In case of marketing orientation, it was found that majority (69.50%) and (74.50%) of the trained and untrained small tea growers possessed medium level of marketing orientation, respectively. It has been also observed that majority of the trained (64.50 %) and untrained (69.50 %) small tea growers possessed medium level of economic motivation. Moreover, majority of the trained (71.00%) and untrained (75.50%) respondents had medium level of risk preference ability. The findings of the study revealed that majority of the trained (70.50%) and untrained (68.50%) respondents had medium level of scientific orientation. Regarding decision making ability majority of the trained (81.00%) and untrained (85.00%) respondents had medium level of decision making ability. The study further revealed that majority of the trained (64.50%) and untrained (70.00%) respondents had medium level of extent of adoption, followed by 18.00 per cent of the trained and 16.50 per cent of the untrained respondents having low level of extent of adoption of recommended tea cultivation practices. Moreover, 17.50 per cent of the trained and 13.50 per cent of the untrained respondents had high level of extent of adoption of recommended tea cultivation practices. A positive and significant relationship was found between extent of adoption and annual income, mass media exposure, extension contact, achievement motivation and scientific orientation of the trained small tea growers. On the other hand, size of operational land holding had a negative and significant relationship with the extent of adoption. A positive and significant relationship was found between extent of adoption and mass media exposure and achievement motivation of the untrained small tea growers. The two sample 't' test between independent variables result revealed that there was positive and significant difference between trained and untrained small tea growers with respect to type of family, mass media exposure and extension contact. The two sample 't' test between dependent variable result revealed that there was positive and significant difference between trained and untrained small tea growers with respect to extent of adoption of recommended tea cultivation practices. It has been observed that trained small tea growers were good adopter of recommended tea cultivation practices than the untrained small tea growers. The major problem faced by the small tea growers in adopting recommended cultivation practices as perceived by them were high cost of planting materials, inadequate knowledge regarding infilling, high cost of some fungicides and fertilizer, inadequate knowledge in the use of pesticides, inadequate knowledge on soil pH and its management, lack of awareness about the method of propagation and advantages of mulching, non availability of pruning machine, lack of courage in taking risk, lack of proper guidance from linkage organisations, inadequate availability of land as per the activity to be carried out, poor economic status of STGs hamper mobilization of labour, lack of knowledge about proper techniques of marketing, high rate of interest of loan/credit, lack of proper transportation facilities and adequate training for skill development.

## **A Study on Sustainable Dry Farming in Central Dry Zone of Karnataka**

*Sachin V. R.*

This study entitled 'A Study on Sustainable Dry Farming in Central Dry Zone of Karnataka' was taken in the central dry zone (agro-climatic zone) of Karnataka state. Thorough review of literature revealed that very less investigations happened in the field of sustainable dry farming. Hence an attempt has been made to make an initial footprints in this untouched but very important field of investigation by framing five specific objectives. The primary data was collected from both dry farmers (N=250) and extension personnel (N=75) by selecting them with the help of multi-stage random sampling technique and the proportionate stratified random sampling technique respectively. The findings of the study in case of profile of the dry farmers revealed that majority of them were found to be 36 to 62 years old (65.60 %), educated up to high school (32.00 %) with 3 to 26 years farming experience (51.20 %) and had 2 to 6 members in their family (86.80 %). Majority of them were small land holders (48.40 %) who were fell in low level in case of their level of HYV index (55.60 %), level of organic manure (86.80 %), level of fertilizers (78.00 %), level of pesticides (98.80 %) and farm power mechanization (75.60 %). While, majority were found in medium level in case of their extension contact (58.40 %), mass media utilization (56.40 %), economic motivation (84.00 %), management orientation (69.20 %), achievement motivation (67.60 %), level of aspiration (93.20 %), decision making pattern (62.00 %) and innovativeness (72.80 %). Whereas, majority were fell in high level in case of their level of rain water harvesting and moisture conservation measures (50.80 %), change proneness (64.00 %), risk orientation (76.40 %) and farming commitment (62.80 %). The findings of the study in case of profile of the extension personnel disclosed that majority were found to be 38 to 59 years old (50.67 %), had master degree in agricultural science (70.67 %), had 1 to 16 years work experience (82.67 %) in the department with 42 to 51 hours work load (49.33 %) in a week and majority were found to have rural background i.e., born in rural areas (84.00 %). Whereas, majority were fell in medium level in case of their mass media exposure (76.00 %), extension service orientation (60.00 %), empathy (82.67 %), job satisfaction (64.00 %), career growth opportunities (88.00 %) and job stress (90.67 %). But majority were reported to have

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**Department: Extension Education**

**Major Adviser: Dr. A.K. Bhattacharyya**

low level of training (65.33 %) in the department, The findings of the study in case of the infrastructure facilities revealed that 'coordination of activities' (89.33 %), 'authority & responsibility' (89.33 %) and 'monitoring & evaluation' (89.33 %) were the most 'timely available and adequate' infrastructure facilities. Whereas, 'training facilities to farmers' (45.33 %), 'resource persons' (30.67 %) and 'vehicles for mobility' (25.33 %) were the least 'timely available and adequate' infrastructure facilities. The findings of the study in case of extension tools and techniques revealed that 'group meeting' (98.67 %) and 'exhibitions' (98.67 %) were the most used extension methods. 'Farm and home visit' (90.67 %) was found to be the most suitable extension method to promote sustainable dry farming. The findings of the study in case of extension programmes disclosed that eight extension programmes were found to have cent per cent functional implementation. 'Raita Siri Programme' (94.67 %) was found to be the most suitable extension programme to promote sustainable dry farming. The findings of the study in case of organizational climate revealed that majority of the extension personnel perceived it as congenial at low level (53.33 %). The 'planning aspect' was found to be the most congenial dimension of the organizational climate. The findings of the study in case of knowledge level of dry farmers on sustainable dry farming disclosed that majority were found to possess medium level (55.60 %) of knowledge. The independent variables of the dry farmers viz., family size ( $r=0.1235^*$ ), landholding ( $r=0.1360^{**}$ ), index of HYV ( $r=0.1062^*$ ), rain water harvesting and moisture conservation ( $r=0.3000^{***}$ ), farm power mechanization ( $r=0.1930^{***}$ ), extension contact ( $r=0.5240^{***}$ ), mass media utilization ( $r=0.3150^{***}$ ), economic motivation ( $r=0.2620^{***}$ ), change proneness ( $r=0.2450^{***}$ ), risk orientation ( $r=0.2220^{***}$ ), management orientation ( $r=0.1900^{***}$ ), farming commitment ( $r=0.3190^{***}$ ), level of aspiration ( $r=0.1770^{***}$ ), decision making pattern ( $r=0.2540^{***}$ ) and achievement motivation ( $r=0.1490^{**}$ ) were found to have positive and significant influence over their level of knowledge. Whereas, the variables viz., level of use of organic manure ( $r=0.0776NS$ ), level of use of fertilisers ( $r=0.0331NS$ ) and level of use of pesticides ( $r=0.0775NS$ ) were had positive and non-significant influence over their level of knowledge. The remaining independent variables viz., age ( $r=-0.0786NS$ ), farming experience ( $r=-0.0742NS$ ) and innovativeness ( $r=-0.0952NS$ ) were had negative and non-significant correlation with the level of knowledge of dry farmers. Also chi-square test revealed that level of education had non-significant association ( $\chi^2=84.650NS$ ) with the level of knowledge of dry farmers. Finally the multiple regression revealed that the variables viz., family size ( $B=0.1357^*$ ), landholding ( $B=0.0838^{**}$ ), extension contact ( $B=0.2599^{***}$ ), mass media utilization ( $B=0.0898^*$ ), economic motivation ( $B=0.3093^{**}$ ), farming commitment ( $B=0.0753^{**}$ ) and decision making pattern ( $B=0.0257^{**}$ ) were found to be the determinant factors of the level of knowledge of dry farmers with the R square value 0.428 ( $F=8.120^{***}$ ). The findings of the study in case of the knowledge level of extension personnel on sustainable dry farming disclosed that majority were found to possess medium level (61.33 %) of knowledge. The independent variables viz., work load ( $r_s=0.371^{***}$ ), training undergone ( $r_s=0.325^{***}$ ), extension



service orientation ( $r_s=0.440^{***}$ ), empathy ( $r_s=0.243^{**}$ ) and carrier/professional growth ( $r_s=0.283^{**}$ ) were had positive and significant relationship with their knowledge level. Whereas, the variables viz., age ( $r_s=-0.321^{***}$ ) and work experience ( $r_s=-0.255^{**}$ ) were had negative and significant influence over the level of knowledge. From the remaining variables, mass media exposure ( $r_s=0.136NS$ ) and job stress ( $r_s=0.072NS$ ) were had positive and nonsignificant relationship and the job satisfaction ( $r_s=-0.059NS$ ) had negative and non-significant correlation with the knowledge level of extension personnel. The chi-square analysis revealed that the level of education ( $\chi^2=53.897^*$ ) had significant association and the rural-urban background ( $\chi^2=36.034NS$ ) had non-significant association with the level of knowledge of extension personnel. The findings of the study in case of resource availability and their extent of adoption revealed that the 'sprinkler irrigation system' (96.00 %) and the 'agricultural labour' (8.00 %) were the most and the least 'timely available and adequate' resources in the central dry zone of Karnataka respectively. Whereas, the 'quality fertilizers' (76.00 %) and the 'vermicompost' (11.60 %) were the resources which got the most and the least full scale adoption in the central dry zone of Karnataka respectively. The 'sprinkler irrigation system' (60.80 %) was the resource which had highest availability-adoption gap. The findings of the study in case of the performance level of extension personnel in promoting sustainable dry farming revealed that majority were found to have medium ( $r_s=81.33$  %) performance level. The independent variable carrier/professional growth ( $r_s=0.327^{***}$ ) had positive and significant influence over the performance level. Whereas, the variable job stress ( $r_s=-0.246^{**}$ ) had negative and significant correlation with the performance level. From the remaining variables, work load ( $r_s=0.187NS$ ), training undergone ( $r_s=0.039NS$ ), mass media exposure ( $r_s=0.088NS$ ), extension service orientation ( $r_s=0.105NS$ ), empathy ( $r_s=0.155NS$ ) and job satisfaction ( $r_s=0.086NS$ ) were had positive and non-significant influence and the variables, age ( $r_s=-0.058NS$ ) and work experience ( $r_s=-0.011NS$ ) were had negative and non-significant influence over the performance level of extension personnel. 'Depleting underground water' (87.60 %) and 'seasonal labour non-availability' (80.00 %) were the top two problems of dry farmers. Whereas, 'need to make MSP to all agricultural crops' (73.60 %) and 'need to fill local water bodies at least once in a year through irrigation channels' (58.00 %) were the top two suggestions of dry farmers to increase the adoption of sustainable dry farming practices. 'Supporting micro irrigation technologies with subsidies' (93.33 %), 'awareness creation about long term benefits of the sustainable dry farming at village levels' (89.33 %) and 'intensification of utilizing MGNREGA scheme to construct water conservation structures' (86.66 %) were the top three suggestions of the extension personnel to increase the adoption of sustainable dry farming practices.

## **High Density Orcharding of Guava (*Psidium guajava* L) cv. Lalit for Assam**

*Anjan Borah*

The present research work entitled, —High Density Orcharding of Guava (*Psidium guajava* L) cv. Lalit for Assam was conducted at the Experimental Farm of Horticultural Research Station, Assam Agricultural University, Kahikuchi, Guwahati during the year 2017–2020 to standardize the planting density and to determine the ideal NPK levels for high-density planting system in Guava for Assam conditions. The experiment was laid out in Factorial Randomised Block Design (RBD) with 3 replications and two factors comprising of four planting densities i.e. S1 (4444 plants ha<sup>-1</sup>), S2 (5000 plants ha<sup>-1</sup>), S3 (6666 plants ha<sup>-1</sup>), S4 (10000 plants ha<sup>-1</sup>) and three fertiliser levels viz., F1 (50:25:15 g NPK plant<sup>-1</sup> for first year and 110:55:45 g NPK plant<sup>-1</sup> for second year), F2 (60:35:25 g NPK plant<sup>-1</sup> for first year and 120:65:55 g NPK plant<sup>-1</sup> for second year) and F3 (70:45:35 g NPK plant<sup>-1</sup> for first year and 130:75:65 g NPK plant<sup>-1</sup> for second year). The significant findings of the present experiment revealed that the high density planting had a substantial impact on plant growth, yield and quality of guava. The highest plant girth, canopy spread, number of branches, total number of leaves, leaf area and leaf area index were recorded in the lowest planting density (S1), while the maximum plant height was observed in the highest density (S4) during winter and rainy seasons of 2018-19 and 2019-20. The significantly higher number of flowers, fruits per branch, highest fruit set and lowest fruit drop was observed in widely spaced populations and the rainy season crop bear more flowers and fruits consistently for the two years, while fruit set percentage was recorded higher in winter season as compared to rainy season crop. The results also indicated that different levels of fertiliser had shown varied responses to vegetative and reproductive growth of plants. The fruit yield per plant increased significantly with decrease in plant population thus, maximum yield (1.74 and 1.83 kg plant<sup>-1</sup>) was obtained in the lowest density (S1) and the minimum (0.75 and 0.78 kg plant<sup>-1</sup>) at highest density (S4) respectively in the year 2018-19 and 2019-20. Further, the highest yield per hectare was obtained in planting density S2 (8.02 t ha<sup>-1</sup>) and S1 (8.15 t ha<sup>-1</sup>), while the lowest was recorded in plants under density S3 (6.04 and 6.76 t ha<sup>-1</sup>).

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**Abstract of Ph. D. thesis**

**Department: Horticulture**

**Major Adviser: Dr. U. Kotoky**

The physical and chemical attributes of fruit were found significantly superior in lower densities during both years and the winter season crop was superior to rainy season in terms of physico-chemical characteristics of fruit. The 7 plants under the lowest population density (S1) yielded fruits with the highest length (5.79 cm and 6.17 cm), maximum weight (124.34 g and 130.21 g), highest volume (116.97 ml and 125.05 ml) and maximum pulp weight (113.39 g and 120.00 g). The lowest number of seeds (223.10 and 231.41), minimum seed weight (3.87 g and 4.37 g) and highest value of pulp:seed ratio were observed in the fruits of plants at the lowest density. The widely spaced population (S1) produced fruits with the maximum ascorbic acid, total sugars, non-reducing sugar, sugar to acid ratio, juice content and minimum acidity during both years, while the highest TSS, reducing sugar and pectin content was obtained in fruits from the plant at density S1 in 2018-19 and S2 in 2019-20. The fertiliser level also impacted the yield and quality of fruit quite significantly, the highest fruit yield per plant (1.54 and 1.64 kg per plant) and maximum yield per unit area (9.06 t ha<sup>-1</sup> and 9.73 t ha<sup>-1</sup>) during the first and second year of investigation was obtained with the application of F3 level of fertiliser. Also, the plants nourished with the highest level of fertiliser (F3) produced fruits superior in quality irrespective of season or year. The plants under the lowest density (S1) had the highest percentage of leaf NPK, while the maximum N (1.52% and 1.61%), P (0.26% and 0.28%) and K (0.62% and 0.63%) was found in leaves of plants treated with F3 level of fertiliser. The total chlorophyll content of leaves was also varied markedly with different levels of plant density and fertiliser, the highest value of chlorophyll content (1.91 mg g<sup>-1</sup> and 2.07 mg g<sup>-1</sup>) was noted in the lowest density (S1), while it was found maximum in the highest level of fertiliser (F3). The interaction of lower plant densities with the highest level of fertiliser produced superior results in comparison to other combinations, the S1F3 and S2F3 treatment combinations resulted in higher yield with superior quality fruits. The highest benefit to cost ratio was estimated to be 3.28 in S1F3 followed by 2.92 in the S2F3 combination. The guava plants grown at population density of 4444 plants ha<sup>-1</sup> with the application of 70:45:35 g NPK plant<sup>-1</sup> in the first year and 130:75:65 g NPK plant<sup>-1</sup> in the second year exhibited optimum growth, higher yield with superior quality fruits and gave higher profitability.

## **Response of crop geometry and management practices on growth and shelf life of strawberry (Fragaria x ananassa Duch.)**

*Himadri Shekhar Datta*

The present study on “Response of crop geometry and management practices on growth and shelf life of strawberry (Fragaria x ananassa Duch)” was conducted at the farmer’s field in Dhankhuloi village of Jorhat district, Assam during the consecutive years 2019-20 and 2020-21 to assess the effects of varied spacing and different mulch material on growth, yield and quality parameters of strawberry. The field experiment was laid out in randomised block design (RBD) with three replications involving twenty treatments comprising of five plant spacings viz., 20 cm x 30 cm (S1), 30 cm x 30 cm (S2), 30 cm x 40 cm (S3), 40 cm x 40 cm (S4), 40 cm x 60 cm (S5) and four different mulch applications viz., paddy straw (M1), red mulch (M2), silver black mulch (M3) and no mulch (M4). After crop harvest, a laboratory experiment was carried out with five treatments involving dipping of freshly harvested berries in Hexanal with varying strengths viz., 1% Hexanal for 2.5 minutes (V1), 1% Hexanal for 5 minutes (V2), 2% Hexanal for 2.5 minutes (V3) and 2% Hexanal for 5 minutes (V4). Undipped berries were considered for control treatment (V5). Both hexanal treated and berries under control treatment were stored at ambient temperature for evaluation of shelf life. The study revealed that the spacing had a substantial impact on crop growth, yield and quality of strawberry. The pooled data revealed that the highest number of leaves per plant (44.55), leaf area (86.77 cm<sup>2</sup>), number of flowers per plant (38.69), root volume (23.62 cc), minimum days from first flower opening to fruit setting (6.30 days) and days required for initiation of first ripening (63.61 days) were recorded in the widest spacing S5 (40 cm x 60 cm) while minimum days to appearance of first flower (37.85 days) was documented in closest spacing S1 (20 cm x 30 cm). The plants under wider spacing S4 (40 cm x 40 cm) yielded fruits with the highest fruit weight (17.96 g) and number of fruits per plant (32.31). The fruit yield per plant increased significantly with increase in plant spacing and registered maximum of 644.31 g per plant in S4. However, the highest marketable yield (11.80 t ha<sup>-1</sup>) was obtained in S1. The physical and chemical attributes of fruits were found to be superior in S5 viz., the maximum total sugar

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(6.31%), reducing sugar (5.59%) and ascorbic acid (78.65 mg 100 g<sup>-1</sup>) including minimum post harvest disease incidence (27.42%) during both the years of study. The vegetative and reproductive growth of plants varied with the type of mulch used. Highest number of leaves per plant (53.67), leaf area (100.75 cm<sup>2</sup>), number of flowers per plant (48.73) along with the minimum days required for appearance of the first flower (34.69 days), days from first flower opening to fruit setting (5.31 days) and days required for initiation of first ripening (53.59 days) were recorded with application of silver black mulch (M3). The maximum number of fruits per plant (42.11), fruit weight (22.40 g), fruit yield per plant (945.87 g) and marketable fruit yield (18.98 t ha<sup>-1</sup>) was obtained with application of silver black mulch (M3). Similarly, treatment M3 produced fruits of superior quality recording the maximum TSS (12.75° Brix), total sugar (6.38%), reducing sugar (5.61%) and ascorbic acid (85.81 mg 100g<sup>-1</sup>) including minimum post harvest disease incidence of 21.37%. The interaction effect of spacing and mulch revealed that maximum fruit weight (23.12 g), total number of fruits per plant (50.49), fruit yield per plant (1167.91 g), total sugar (6.49%) and reducing sugar (5.72%) was recorded with the treatment combination T15 (40 cm x 40 cm spacing with silver black mulch). The highest marketable yield (22.75 t ha<sup>-1</sup>) was obtained in T3 (20 cm x 30 cm with silver black mulch). However, the treatment combination T15 yielded highest benefit: cost ratio (3.07). Dipping of fruits in 2% Hexanal for 2.5 minutes (V3) was found to be the most efficacious treatment for prolonging shelf life of strawberry. Maximum fruit firmness (5.88 N mm<sup>-1</sup>) and shelf life (5.90 days) was obtained in treatment V3, thereby extending the marketing period of the fruit. Based on yield, quality and economics, the treatment combination T15 (40 cm x 40 cm spacing with silver black mulch) was found to be the most viable economic proposition for strawberry in Jorhat condition of Assam. Additionally, dipping the berries in 2% Hexanal for two and half minutes extended the shelf life of strawberry. Thus, the research investigation highlighted the fact that crop geometry and management practices govern yield parameters and shelf life of the high valued crop, strawberry.

## **Quality planting material generation of Early Cauliflower in greenhouse for higher production and productivity**

*Nayanmoni Buragohain*

An experiment was conducted at the greenhouse and in the field of the Experimental Farm, Department of Horticulture, College of Agriculture, Assam Agricultural University, Jorhat and at Farmer's field, Korongakhat village, Dhekiajuli, Jorhat for two consecutive years (2018 and 2019) to generate quality planting material of early cauliflower in green house for higher production and productivity and to evaluate their performance in the field condition. The experiment was laid out in Randomized Block Design with eight treatments comprising of four sowing media [M1-cocopeat (60): vermiculite (20): perlite (20), M2- cocopeat (50): vermicompost (50), M3-cocopeat (50): vermicompost (50): microbial consortium and M4-Conventional nursery] and two varieties [V1 (White Diamond) and V2 (CFL1522)] replicated thrice. In the present study, all the growth parameters at seedling stage were significantly influenced by sowing media. The effect of variety was found significant for days to 2-true leaf emergence, leaf area, seedling fresh and dry weight, seedling growth index and root length. The highest seedling emergence (93.00%) was recorded in sowing media M1 whereas minimum days to transplanting (22.25), maximum leaf area (11.14 sq.cm), stem diameter (0.50 cm), highest seedling fresh (5.44 mg) and dry weight (0.64 mg) was recorded in M2. Minimum days for 2-true leaf emergence (10.75) was recorded by variety V2 while highest leaf area (10.86 sq.cm), seedling fresh weight (4.12 mg) and dry weight (0.43 mg), seedling growth index (1254.49) and root length (4.24 cm) were recorded by V1. Among interactions, M2V1 recorded maximum leaf area (11.97 sq.cm), stem diameter (0.53 cm), seedling fresh and dry weight (5.50 and 0.66 mg) respectively, root length (5.83 cm), relative water content (92.06 %), dry matter accumulation (12.19 %), palisade ratio (1.58); M1V1 recorded maximum emergence (93.79 %), M2V2 recorded minimum number of days (9.50) for 2-true leaf stage, least number of days (22.17) to transplanting, maximum stomata number in upper and lower surface (87.11 and 154.75). The highest curd weight (0.41 kg) and yield (200.22 q/ha) was recorded in

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M3 and among interactions M3V2 recorded the highest curd weight (0.41 kg) and yield (202.13 q/ha). Similar observations were recorded in Farmer's field also where media had significant influence for all the parameters and variety showed significant variation for limited parameters. The highest benefit: cost ratio (3.95) was recorded in M3V1 (cocopeat (50): vermicompost (50): microbial consortium and variety White Diamond) while M3V2 (cocopeat (50): vermicompost (50): microbial consortium and variety CFL 1522) registered a B: C ratio of 3.90. Considering the crop performances, sowing media comprising of cocopeat (50): vermicompost (50): microbial consortium (@ 1:100 can be suggested for raising quality seedlings in the greenhouse to get higher yield and maximum return for early cauliflower cultivation.

## **Standardization of organic inputs in pineapple cv. Kew**

*Nishita Pathak*

An investigation on —Standardization of organic inputs in pineapple cv. Kew— was conducted during the year 2018 - 2020, in the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat. The field experiment was laid out in Factorial Randomized Block Design (RBD) with ten treatments replicated three times. The ten different treatments were FYM @ 5 tonnes/ha + Wood ash @ 0.8 tonnes/ha (T1), FYM @ 10 tonnes/ha + Wood ash @ 0.8 tonnes/ha (T2), Vermicompost @ 2.5 tonnes/ha + Wood ash @ 0.8 tonnes/ha (T3), Vermicompost @ 5 tonnes/ha + Wood ash @ 0.8 tonnes/ha (T4), T1 + Microbial Consortium @ 20 kg/ha (T5), T2 + Microbial Consortium @ 20 kg/ha (T6), T3 + Microbial Consortium @ 20 kg/ha (T7), T4 + Microbial Consortium @ 20 kg/ha (T8), Microbial Consortium @ 20 kg/ha (T9) and RDF (T0, control). The results so obtained showed that, reproductive and quality parameters were significantly influenced by the various treatments. Among the various treatments, T8 was found to be the best in increasing the growth parameters viz., plant height (103.18 cm) at 360 DAP, number of leaves (70.00) at 540 DAP, length of D leaf (67.47 cm), breadth of D leaf (5.37 cm), leaf area (291.38 cm<sup>2</sup>), leaf area index (2.65), shoot and root ratio (12.23), root length (46.57), number of flower per inflorescence (91.89) and also earliness in flowering was observed. Fruit weight with crown (1.78 kg), fruit weight without crown (1.54 kg), fruit length (15.94 cm), fruit breadth (13.15 cm), fruit volume (1228.52 cc) and fruit yield (56.07 t/ha) were also found to be significantly higher in treatment T8. Similarly in case of quality parameters viz., TSS (15.93 °Brix), reducing sugar (5.63 %), total sugar (9.75 %), ascorbic acid (26.16 mg/100g) and moisture percentage (87.12) recorded significantly higher values in treatment T8. Regarding nutrient status of the soil the results revealed that, the available N (270.84 kg/ha), P (60.02 kg/ha) and K (138.65 kg/ha), organic carbon (0.92 %), soil pH (5.56), microbial biomass carbon (500.67 µg g<sup>-1</sup> soil), microbial population viz., bacteria (7.27 log cfu g<sup>-1</sup> soil) and fungi (5.01 log cfu g<sup>-1</sup> soil) and soil enzyme activity i.e, Dehydrogenase (179.01 µg TPF g<sup>-1</sup> soil 24 hour<sup>-1</sup>), Phosphomonoesterase (342.62 µg pnitrophenol g<sup>-1</sup> hour<sup>-1</sup>) and Fluorescein di-acetate (6.90 µg fluorescein g<sup>-1</sup> h<sup>-1</sup>) were found to be significantly higher in treatment T8. 6 Based on the results obtained

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during the investigation, it can be concluded that, pineapple plants cv. Kew when applied with Vermicompost @ 5 tonnes/ha + Wood ash @ 0.8 tonnes/ha + Microbial Consortium @ 20 kg/ha (T8) resulted in better growth with improved fruit quality and higher benefit: cost ratio (3.03).

## **Post-Harvest Quality Enhancement in Banana cv. Grand Naine**

*Swosti Debapriya Behera*

An experiment on „Post harvest quality enhancement in banana cv. Grand Naine“ was conducted in kharif season of 2017-18 and 2018-19 in the Orchard and Quality Control laboratory, Department of Horticulture, Assam Agricultural University, Jorhat to study the effect of various pre and post harvest treatments on post harvest quality and shelf life of banana. Two pre harvest treatments B<sub>1</sub> (Bunch spray of sulfate of potash 2% + calcium chloride 2%), B<sub>2</sub> (Bunch spray of sulfate of potash 2% + micro nutrient Tracel 2%) and six post harvest treatments H<sub>1</sub>( Dipping hands in 1% chitosan solution for 2 minutes), H<sub>2</sub> (Dipping hands in 30 ppm Benzyl adenine solution for 10 minutes), H<sub>3</sub> (Dipping hands in 2% calcium chloride solution for 5 minutes) H<sub>4</sub> (Dipping hands in 1% Garlic extract for 4 hours), H<sub>5</sub> (Dipping hands in Gibberelic acid 150 ppm solution for 1 minute), H<sub>6</sub> (Control or Hands without any treatment) were applied to fruits. Fruits were subjected to post harvest treatments immediately after harvest and kept at ambient conditions (mean temp. 21.8 ± 2.3°C; mean RH 85 ± 10%). Physicochemical properties and enzyme activities were studied at harvest and across storage at 3 days (S<sub>1</sub>), 6 days (S<sub>2</sub>), 9days (S<sub>3</sub>) and 12 days (S<sub>4</sub>). The laboratory experiment was laid out in a factorial completely randomized block design with three replications. Among pre harvest treatments, sulfate of potash 2% + micro nutrient (Tracel 2%) proved better in improving fruit qualities. On 12<sup>th</sup> days after storage, maximum TSS ( 25%), Reducing sugar (17.83%) , Non reducing sugar (11.13%) and Total sugar (28.97%) were recorded in B<sub>1</sub>H<sub>6</sub> ( spray of sulfate of potash 2% + calcium chloride 2% + control) while minimum content was found in B<sub>2</sub>H<sub>5</sub> (sulfate of potash 2% + micro nutrient (Tracel 2%) + GA<sub>3</sub> 150 ppm i.e. 18.72%, 9.03%, 7.40% and 16.44%, respectively. B<sub>2</sub>H<sub>6</sub> registered the lowest titrable acidity (0.32%) which was followed by B<sub>1</sub>H<sub>6</sub> (.322%) and B<sub>2</sub>H<sub>1</sub> (0.357%). Maximum retention of ascorbic acid (4.71 mg/100g), crude protein (3.25%), crude fibre (0.42%), pectin (2.38%) and the lowest phenol content (25.50 mg/ 100g) were obtained in B<sub>2</sub>H<sub>5</sub> . Pectin methyl esterase activity in pedicel was the highest i.e. 37.34 units / mg protein on 12<sup>th</sup> days of storage in B<sub>1</sub>H<sub>6</sub> and the lowest activity (20.84 units / mg protein) was found in B<sub>2</sub>H<sub>5</sub>.

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In pedicel, its activity was higher than that of peel. Physiological loss in weight (PLW) and rotting of fruits were increased during storage. B<sub>2</sub>H<sub>5</sub> recorded the lowest PLW (10.39%) on 12<sup>th</sup> days after storage and absence of rotting of fruits which was followed by B<sub>2</sub>H<sub>3</sub> (10.92%). Organoleptic qualities of fruits were found to decrease with the advancement of storage period. The highest score values in respect of colour (9), flavour (8.67) and overall acceptability (9) were obtained in sulfate of potash (2%) + Tracel 2% + post harvest treatment of Gibberelic acid 150 ppm followed by sulfate of potash (2%) + Calcium chloride (2%) + Post harvest treatment of Gibberelic acid 150 ppm which was having highest taste score (9) and texture value (8.73). Maximum shelf life of 15 days was recorded in sulfate of potash (2%) + Tracel 2% + post harvest treatment of Gibberelic acid 150 ppm while the lowest of 9 days was found in sulfate of potash (2%) + Calcium chloride (2%) + Control. The former treatment is also very cost effective while comparing with other treatments. Thus, it may be suggested that pre harvest treatments with sulfate of potash (2%) + Tracel 2% and post harvest treatment of Gibberelic acid 150 ppm (1 min) appeared to be the best treatment with minimum pectin methyl esterase activity, physiological weight loss, rotting and microbial activities retaining maximum pectin, crude fibre, protein which extended the shelf life up to 15 days at ambient conditions.

## **Bio-management of disease complex of *Meloidogyne incognita* and *Fusarium oxysporum* f.sp *ciceri* on chickpea (*Cicer arietinum.*, Butler 1918)**

***Pallabi Roy***

In the present study on the interaction of *Meloidogyne incognita* and *Fusarium oxysporum* f.sp *ciceri* on chickpea, the result indicated that dual inoculation treatments significantly decreased plant growth parameters over the treatment with *M. incognita* @1000 J2/kg soil and *F. oxysporum* @ 2% (w/w). The treatment with *M. incognita* @1000 J2/kg soil + *F. oxysporum* @ 2% (w/w) after 15 days of inoculation was statistically superior in decreasing the plant growth parameters of chickpea. However, number of galls, eggmasses, final nematode population was found maximum in single inoculation treatment than dual inoculation treatments. The highest number of galls, eggmasses, final nematode population were observed in the treatment with *M. incognita* @1000 J2/kg soil. The maximum disease incidence was recorded in the treatment with *M. incognita* @1000 J2/kg soil and *F. oxysporum* @ 2% (w/w) after 15 days of inoculation. Studies on the management of disease complex of *Meloidogyne incognita* and *Fusarium oxysporum* on chickpea with microbial consortia, vermicompost and *Glomus fasciculatum* alone or in combination under microplot condition showed that all the treatments differed significantly over untreated control in respect of increasing plant growth parameters and yield of chickpea. The seed treatment with microbial consortia @ 5ml/l + soil application of vermicompost enriched microbial consortia @ 2t/ha + seed treatment with microbial consortia @ 5ml/l + soil application of *Glomus fasciculatum* spores/m<sup>2</sup> was found to be most effective in increasing plant growth parameters, yield, N,P, and K content in soil. All the treatment significantly decreased the number of galls, eggmasses, nematode population and fungal population in soil and percent disease incidence. In the pilot field trial, conducted at farmers field with the best treatment combination found under microplot trial for the management of disease complex of *Meloidogyne incognita* and *Fusarium oxysporum* on chickpea showed that the seed treatment with microbial consortia @ 5ml/l + soil application of vermicompost

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**Major Adviser: Dr. A. Borah**

enriched microbial consortia @ 2t/ha + seed treatment with microbial consortia @ 5ml/l + soil application of *Glomus fasciculatum* spores/m<sup>2</sup> effective in increasing plant growth characters, yield and reducing in number of galls, final nematode population in soil and percent disease incidence over untreated control.

## **Morpho-physiological and molecular characterization for phosphorus use efficiency of Assam rice (*Oryza sativa* L.)**

*Letngam Touthang*

The present investigation was carried out to identify Phosphorus (P) efficient rice genotypes and their inheritance/combining ability genetics. A set of 80 rice genotypes comprising landraces and improved lines of Ahu and Sali were screened for Phosphorus starvation Tolerance 1 (PSTOL1) gene using seven core dominant Pup1 markers. Based on molecular data, a set of 32 genotypes were selected for field characterization under three graded doses of P (0, 20 and P2O5 ha<sup>-1</sup>) during Sali season 2018 in RBD, with three replications. A pot experiment for screening the root characteristics was conducted during Ahu 2019 using the same soil of the experimental site. Based on molecular, Biochemical parameters and field characterization, six parents viz., Ikhojoi, Balighungoor, Rangoli, Banglami, TBK-7-2 and Kasalath were selected and crossed in half diallel design during Sali 2019. Evaluation of F1s diallel population was conducted during Ahu 2020. Molecular screening using seven dominant Pup1 specific core markers revealed the probable presence of the Pup1 gene in various genotypes. The highest Kasalath (K) allele frequency of 65% was amplified by K-46-2 (227 bp) followed by K-46-1 (57.5%) at 523 bp, K-41 (56.25%) at 382 bp, and K-52 (50%) at 505 bp, respectively. The UPGMA Hierarchical clustering grouped the 80 genotypes into six clusters and 26 genotypes which consistently amplified all the seven core Pup1 specific markers were grouped into the same cluster with Kasalath. The performance of genotypes across the graded P-doses revealed delayed flowering/maturity with a reduction in yield and its contributing traits with decreasing P-application. The analysis of variance showed the presence of high significant genetic variation among the genotype. Except for days to heading, days to fifty percent flowering, days to maturity and grain harvest index, all the quantitative parameters showed high significant G x P interaction. Recorded days to maturity ranged from 104.89 (Koiyapuri) to 118.72 (Dimrou), Shoot P-content ranged from 1.6 mg/g (Basmati Red) to 2.5 mg/g (Kolong), Grain P-content ranged from 1.43 mg/g (Basmati Red) to

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**Major Adviser: Dr. Debojit Sarma**

2.65 mg/g (Kasalath), Shoot P-uptake ranged from 31.47 mg/hill (Haru Begunigootia) to 66.59 mg/hill (Kolong), Utilization efficiency of P from 3.4 g/g (Bormekohi Dhan) to 15.6 g/g (Balighungoor), Grain ranged from 14.1 q/ha (Basmati Red) to 37.93 q/ha 6 (Kolong). Principal component analysis (PCA) using 31 traits among the 32 diverse rice genotypes produced six principal components (Eigenvalue>1), where the first three components accounted for 73.29% of the total variation. Based on three sensitive Ptolerance indexes viz., P-uptake, P-use efficiency, and grain yield per hectare, 32 rice genotypes diverged into highly P-deficiency tolerance, moderately tolerance, and nontolerance group with 62 % dissimilarity coefficient. The PCV values of all traits were higher than the corresponding GCV values, and a mean heritability ( $h^2$  bs) of 61.63% was apparent among the traits. High heritability (>60%) was evident in 19 traits, moderate heritability (40-60%) 7 traits and low heritability .

## **Functional analysis of nutraceutical properties for different types of rice**

*Smrita Gogoi*

Traditional rice genotypes are endowed naturally with a wide range of nutraceutical properties and thus constitutes to be a potential functional food for nutritional security. The present investigation was undertaken with the objectives to study the diversity of different rice genotypes for yield and yield attributes with varying nutritional components especially iron and zinc. The differential expression of the genes for anthocyanin biosynthesis in relation to iron and zinc content in rice grain and genome wide association study to identify significant marker trait associations for yield and grain quality in rice germplasm collection was also done in the present study. A group of 204 rice genotypes comprising of traditional rice including ahu, Sali, bao, aromatic and glutinous genotypes along with a few high yielding released varieties and high zinc breeding lines developed in IRRI, Philippines were evaluated during Sali 2019-20 in augmented block design and observations were taken for quantitative and qualitative traits as per DUS guideline including important phytochemicals using standard procedure. Out of these, Disang and Dimrou, were recorded as earliest flowering and maturing genotypes, whereas Gopinath and Horu Jahinga possess more number of productive tiller per plant. Joha (Meghalaya) was recorded for high spikelet fertility, whereas Horu Jahinga, Jengoni, and Kajoli chokuwa were recorded high seed yield per plant. To authenticate the common perception of high nutritional value of traditional pigmented rice genotypes, phytochemical analysis were done for 30 genotypes which were selected based on high Fe, Zn content and aleurone colour. Pigmented rice genotypes; Tulashi bora, Ikhojoy, Aus joria and Jengoni were recorded high phytochemical content along with higher Fe and Zn. Jengoni was also recorded high grain yield per plant along with biological yield per plant. Hence, Jengoni along with Tulashi bora, Ikhojoy and Aus joria are identified as promising genotypes for future nutritional breeding combining with good yield. A high significant correlation was also observed between total phenolics and antioxidant activity with total anthocyanin activity. For expression analysis, 5 genotypes were selected including one check i.e. Bahadur, on the basis of high Fe and Zn content and aleurone colour. Seven

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**Major Adviser: Dr. Sharmila Dutta Deka**



gene specific primers were designed to study the expression profile in selected genotypes by double delta CT method. The results indicated that there is no direct relationship between anthocyanin and micronutrient content and thus warrants possibility of involvement of different genes other than the tested ones. Genotyping by 6 sequencing using SNP marker was done for the present set of 204 diverse rice germplasm by outsourcing and marker and trait associations for yield and grain quality in rice germplasm collection for 20 traits was investigated. Out of the 20 traits and 75,309 SNPs analyzed, 30 SNPs showed significant associations with plant height, stem length, spikelet fertility and 1000-grain weight and Zn content. Among the 30 SNPs only 18 SNPs were encoded and co-located with major candidate genes. Moreover, for spikelet fertility and 1000-grain weight, four novel QTLs were detected, which were mapped on chromosome 5 and 7 at 12336034bp and 9597295bp position, respectively for spikelet fertility and on chromosome 7 and 12 at position 13808132bp and 6012015bp for 1000-grain weight. Further characterization and validation of the novel QTLs may lead to the identification of new candidate genes for these traits.

## **Evaluation of aromatic rice genotypes against blast and its biointensive management under rainfed condition**

*Badana Manoj Kumar*

Rice blast caused by *Pyricularia oryzae*, has gained the status of major disease of rice, and it infects almost all the rice growing areas throughout the world. And it is predicted as a major disease in India and in the recent times, the disease has been observed to show an increasing trend in rice fields of Assam, and it causes yield losses varies from 1 to 100%. In the present study evaluation of aromatic rice varieties for resistance and susceptibility against blast was done and studied the effect of management strategies under field condition in Assam. Among the thirty varieties tested with artificial inoculation, none of the varieties shows highly resistance (ie., completely free from the disease) and highly susceptibility whereas, fourteen varieties showed resistant reaction, while five varieties showed moderately resistant, eight varieties showed moderately susceptibility and three varieties shows susceptibility reaction. Addition to that total genomic DNA was extracted from the blast culture were subjected to PCR assay using ITS 1 and ITS 4 primers. BLAST analysis of the samples showed the similarity percentage of 99-98% with the other isolates. Phylogenetic analysis was done with the help of Mega X software, it was found that the samples were closely related with *Pyricularia oryzae* Meghalaya isolate JX469384. Biochemical analysis was evaluated in both healthy and infected leaves of resistant and susceptible aromatic rice genotypes. The resistant entries possess a higher amount of phenols and lower amount of total proteins and total soluble sugars as compared to the susceptible one. After the infection the phenols content was increased in infected leaf as compared to the healthy one in all the entries whereas the total proteins and total soluble sugars were decreased in infected leaf as compared to the healthy one in all the entries. Among the different date of sowing, highest incidence of blast disease (30.35% and 32.81%) were recorded in crop showed on 13th July of 2019 and 2020 respectively. Whereas lowest incidence of blast disease (6.72% and 7.14%) were recorded in crop showed on 15th June of 2019 and 2020 respectively. Correlation studies on the influence of weather parameters on

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**Abstract of Ph. D. thesis**

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**Major Adviser: Dr. B. C. Das**

blast disease development revealed that maximum and minimum temperature, evening relative humidity, rainfall and rainy day were negatively correlated with disease development whereas, relative humidity morning and bright sun shine hours shows positive correlation with the disease development. Multiple regression analysis indicates that, by using max temperature, relative humidity evening and bright sun shine hours could predict the blast disease incidence up to 98% in future in that area. In vitro evaluation of Botanical viz., Mustard oil cake (MOC) and compost materials viz., Farm yard Manure (FYM) and Vermi compost (VC) against blast revealed that MOC at 0.2% concentration showed highest inhibition of pathogen over control i.e., 46.27% after 7th day followed by MOC at 0.1% shows 39.02% and VC at 0.2% concentration shows 36.67 % inhibition over control respectively. Among the three different bio agents i.e., *Trichoderma harzianum*, *T. viride* and *T. koningii*, all of them showed significantly inhibition of the pathogen in vitro but higher percentage inhibition over control showed by *T. harzianum*, i.e., 97.41%. In vivo condition, Seed treatment with *Trichoderma harzianum* amended with MOC (20%) + cow urine (5%) shows less percent disease incidence i.e., 4.30% and 5.73% after 15 and 30 days after sowing in the nursery respectively. Whereas, in field condition, *Trichoderma harzianum* amended Extract of MOC at 20% concentration showed less percent disease incidence i.e., 5.64 %, 9.85 % and 24.31 % and less percent disease severity i.e., 3.74%, 7.96% and 9.67% after 45, 60, 75 days after showing respectively. Followed by *Trichoderma harzianum* amended Extract of MOC at 10% and *Trichoderma harzianum* amended Extract of VC at 20% concentration respectively.

## **Molecular epidemiology of viral disease complex of *Capsicum chinense* Jacq. in North Eastern Region of India**

*Chingakham Inao Khab*

Viral disease complex of *Capsicum chinense* Jacq. were the major constraint facing by king chilli growers in North Eastern Region (NER) of India in recent decades. A total of 94 samples were collected from Assam (36), Arunachal Pradesh (12), Nagaland (10), Meghalaya (8) and Manipur (28). Both DNA & RNA were isolated and detected CMV, PVY, ChiLCV & GBNV. Peculiar symptoms of shoestring, vein banding, leaf puckering, leaf curl and leaf necrosis were observed. Moreover, unknown mix viral infection symptom like yellowing, stunted growth were also observed. Severe symptoms as well as highest vectors population were observed in Assam and lowest in Meghalaya. After PCR base detection, CMV has the highest per cent infection in NER of India (47.88%) followed by PVY (8.58%), ChiLCV (8.34%) and GBNV (4.55%). CMV was detected from all the five states of north east India. The highest disease incidence of CMV was observed in Manipur (53.57%) and lowest in Meghalaya (37.50%). PVY was detected from Assam and Manipur with an incidence of 26.31 and 16.66% respectively. ChiLCV and GBNV were detected from Assam only with an incidence of 26.31 and 16.66% respectively. With respect to altitude, CMV was more prevalent at the mid-altitude (200-800 m a.s.l.) with 54% and followed by low altitude (800 m a.s.l.) with 47%. Whitefly prevalence depending on altitude; at low altitudes (0-200 m), 35% of the plants sampled were colonized by more than five whiteflies and 38% of the plants no whiteflies were detected. Although 49% of the plants sampled at midaltitude (200-800 m) were not colonized, 33% were colonized by one to five whiteflies, and the remaining 17% by more than five. At high altitudes (>800 m a.s.l.), no whiteflies were detected on 92% of the plants. Those mix viral infection of king chilli leaves was done Next Generation Sequencing (NGS) in Illumina platform. A data of 3.75 GB was generated in which 66.2% of chilli genome were mapped. The unmapped read data was 1.4 GB. After Denovo assembly, 51.9 Mb was generated and subjected to BLAST in NCBI. A total of 27 different isolates of king chilli viruses were

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revealed and 6 viruses were novel in NER of India viz., Pepper cryptic virus, Pepper vein yellows virus, Tomato ringspot virus, Capsicum frutescens endornavirus, Alphaendorna virus and Pepper leafroll virus. The highest occurrence virus was pepper vein yellow virus (10/27) and followed by Pepper cryptic virus (6/27), Capsicum frutescens endornavirus (4/27) and Chilli veinal mottle virus (3/27) respectively. The single occurrence viruses were Tomato ringspot virus, Potato virus Y, Pepper leafroll virus and Alphaendorna virus. All the NGS viruses were ranged 87-100 % homology to NCBI database.

## **Development of RNAi construct and optimization of in vitro regeneration and transformation protocol against Banana bunchy top virus**

*Dipshikha Kaushik*

Banana bunchy top disease (BBTD) is one of the most destructive viral diseases responsible for huge destruction in the crop yield, caused by the banana bunchy top virus (BBTV). Currently, there are no strategies available to completely protect bananas against the BBTV. Therefore, in this study, an attempt was made to develop an RNAi construct for bunchy top disease management in bananas. Here, Nuclear shuttle protein (NSP) gene encoded by BBTV DNA-6 was targeted. The Coat protein gene (CP) encoded by BBTV DNA-3 and Nuclear shuttle protein(NSP) gene encoded by BBTV DNA-6 were initially cloned in pGEMT-easy vector. The clones were confirmed by colony PCR, restriction digestion, and sequencing. Sequence results were 96.69% and 94.18% similar to BBTV accessions KX592198 and KX592200 for BBTV-DNA-3 and BBTV-DNA-6 sequences, respectively. Also, NSP gene fragment (500bp) was successfully cloned in sense orientation in an RNAi vector pHANNIBAL. For the process of callus induction, 1-10 weeks old immature male flower buds (IMB) were selected. The immature flowers from position 8th to 16th were isolated and cultured on Murashige and Skoog medium (MS) (HIMEDIA) with CaCl<sub>2</sub>, Vitamins, Sucrose and Agar (REF PT100-10x1L). The medium was supplemented with NAA, IAA, 2,4-D and Malt extract each in the concentration of 1mg/lit. The efficiency of embryogenic callus formation from Grand Naine male flower bud was 6% ± 0.021. Two suppressor genes, DNA3\_Jorhat and DNA4\_Jorhat showed 98.66% (KX249744) and 97.54% (KX249745) similarity with Assam isolates. Transmission study using 15 to 30 aphids was confirmed by the LAMP detection technique in 10-fold dilutions of DNA concentrations at 100 ng to 0.0001 ng. Phylogenetic relationships shared by the Jorhat isolates with the different isolates from India and the world allowed a deeper understanding of the evolution and spread of viruses. Leaf samples confirmed through transmission studies were only used for biochemical analysis. These findings indicate that there was a significant increase in the peroxidase (POX), polyphenol oxidase (PPO), and antioxidant activity in the BBTV infected plant (P<0.05). The total alkaloid was found to be significantly decreased in BBTV infected plant as compared to the

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healthy plant ( $P < 0.05$ ). IC<sub>50</sub> value calculated for BBTV infected plant was 32.3 µg/ml as compared to a healthy plant 55.9 µg/ml. Alkaloid content in a diseased plant was  $3.35 \pm 0.079$  and in a healthy non-inoculated plant it was  $7.87 \pm 0.067$ . These enzymes could be considered as biochemical markers for studying plant virus interaction.

## **Development of mapping population and use of SSR markers for breeding disease resistance against tomato leaf curl virus**

*John Oladeji Oladokun*

Tomato leaf curl disease (ToLCD) caused by the tomato leaf curl virus (ToLCV) has been a serious threat to tomato crops for decades and breeding genotypes resistant to ToLCD is a sustainable management option. An open field screening was conducted in an augmented design between 2018 and 2019 which was aimed at identifying resistance in 39 tomato genotypes, and developing mapping populations for genetic and inheritance trait analysis in the population. Symptoms associated with ToLCV were recorded, importantly leaf curls incidence alone accounted for 53% (in single infection). The highly resistant genotypes are EC164563, 171, EC520078-B, EC165690, IIHR 2904, H24, *S. pimpinellifolium*, IIHR 2871, IIHR 2862, EC157568, EC521067-B, and IIHR 2867 with incidence ranging between 8.3-18.2%  $\pm$  12.3. The *S. pimpinellifolium* was selected for further studies. There was a significant relationship between whitefly population  $\times$  minimum temperature ( $r = -0.973$ ,  $P=0.05$ ), whitefly population  $\times$  relative humidity ( $r = -0.996$ ,  $P=0.05$ ) and whitefly population  $\times$  average disease incidence ( $r = 0.996$ ,  $P=0.05$ ). Out of 60 symptomatic and asymptomatic bulked leaf samples tested by PCR with six different primers targeting different components of the genome, only 32 (53.3%) were confirmed to be ToLCV infected. The nucleotides of sequence Jorhat isolates of the DNA- $\beta$  satellite component of ToLCV (accession number: MZ2962423, MZ2962424, MZ2962425) similarity identity falls between 99.4 to 99.5 % with ToLCBDB (accession number AJ542489) and a closed cluster with two ToLCBDB isolates (AJ542489 – tomato, MN985116 – country bean) in the phylogenetic tree. One hundred and twenty (120) SSR markers were screened for parental polymorphism check between Pusa Ruby (susceptible) and *S. pimpinellifolium* AAU2019 (resistant), only 11/120 were polymorphic while 109 /120 were monomorphic. In the cross of Pusa Ruby  $\times$  *S. pimpinellifolium* AAU2019 and other generations F2 (self-pollinated F1), and B1F1 or BCs, developed and screened for ToLCV infection in the field, disease incidence was lowest in *S. pimpinellifolium* AAU2019 (7.3 %) followed by F2 (33.3%) but higher in Pusa Ruby (91.3%) when

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genetic control in *S. pimpinellifolium* AAU2019 was studied. Using a co-dominant marker (SSR 63), the inheritance and genetic analysis study of resistance to ToLCV in an interspecific cross (Pusa Ruby × *S. pimpinellifolium* AAU2019) in different mapping populations by 8 SSR63 molecular marker revealed a monogenic recessive (best-fit ratios 3:1, 1:1) nature of ToLCV resistance. Progenies of F<sub>2</sub>, and B<sub>1</sub>F<sub>1</sub> or BCs generations tested for ToLCV DNA varied in terms of the intensity on resolve in gel electrophoresis using the same DNA concentration and compared to Pusa Ruby with higher intensity and not in *S. pimpinellifolium* AAU2019. However, the type of resistance derived and inherited from *S. pimpinellifolium* AAU2019 is assumed to be controlled by a single gene in a recessive state and it is neither fixed nor dominant. This is based on the genotypic segregating pattern, responses of the generations developed to ToLCV infection. Hence, this study provides the potential of *S. pimpinellifolium* AAU2019 as an alternative breeding source for developing resistant cultivars against ToLCV.

## **Elimination of Potato viruses from the local land races through in-vitro culture**

*Jutimala Phookan*

The present investigation on local landraces of potatoes from Assam was conducted to eliminate the viral infections. For this the local landraces were collected from different districts of Assam viz., Jorhat, Biswanath, Sonitpur, Barpeta, Dibrugarh and Kokrajhar. Different symptoms like puckering of leaves, cupping of leaves, leaf rolling, purple colouration on leaves, calico pattern, mosaic symptoms, crinkling of leaves, etc. were observed. It was observed that the landrace from Barpeta had the highest disease incidence of 62.22 per cent and the lowest incidence of 10.00 per cent was observed in Badami also collected from Kokrajhar. PCR analysis of the symptomatic samples showed the presence of different viruses like PVY, PLRV, PVM, PVX, PVS and AMV. The potato tubers were also subjected to PCR analysis and only PLRV was detected with the highest incidence in Barpeta landrace (75.00 %). The growth and yield attributing characters of the landraces collected were also recorded. Plant height was observed to be highest in the landrace of Dibrugarh with 43.36 cm. The highest number of branches was observed in Dibrugarh landrace. The weight of tubers per plant was observed to be highest in case of Dibrugarh landrace (383.48 g). In the in vitro studies, three types of explants (nodal segment, tuber eyes and apical meristem) with two types of media (MS and PM media) were used to conduct the experiment. Among the various hormonal combinations used for shooting, the best hormonal combination observed was 2 mg/ l GA3 + 4mg/ l NAA + 2 mg/ l BAP irrespective of the explant and media used in case of the parameters viz., time required for shooting, number of shoots developed and length of shoots. Similarly in case of rooting the best hormonal combination observed was 1.5 mg/ l IAA + 1.5 mg/ l GA3 + 1.5 mg/ l KIN irrespective of the explant and media used in case of the parameters viz., time required for rooting, number of roots developed and length of roots. The potato plantlets survived highest (86.67 %) when grown from tuber eyes whereas the disease incidence of PLRV was lowest (20.00 %) in case of plantlets grown from apical meristem. Further SAR chemicals were applied exogenously in the potato plants grown in field condition and it was observed that BTH applied at 1.5 mM had the highest reduction of incidence over control (87.03 %). The results of application of SAR chemicals were also supported by

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the biochemical analysis of DAB assay and PPO assay. On application of thermotherapy, no disease incidence was observed at 40 °C for 2 hours 30 minutes where germination was 50 per cent.

## **Diversity of bacteriophages infecting *Ralstonia solanacearum* and their application as bio control agents**

*Parinda Barua*

Bacterial wilt caused by *Ralstonia solanacearum* is one of the most destructive plant diseases of the world that is very difficult to manage. Sustainable management of *R. solanacearum* using bacteriophages is one of the most promising yet unexplored areas of biological control in India. In the present study, 50 *R. solanacearum* isolates were collected from various bacterial wilt infected fields in 5 districts of Upper Brahmaputra Valley Zone (UBVZ) of Assam namely Golaghat, Jorhat and Sivsagar, Dibrugarh and Tinsukia from several crops like bhut jolokia, chilli, capsicum, tomato, brinjal, wild brinjal, potato and ginger. This was followed by isolation of seven lytic phages of *R. solanacearum* from soil from bhut jolokia fields of Jorhat, Assam. After six rounds of purification of the phages, the plaque morphology, phage titre and the multiplicity of infection (MOI) was determined where it was observed that phage RSP1 had the biggest plaque size ( $3.28 \pm 0.40$  nm) and phage RSP4 had the highest titre ( $1.2E+09$  PFU/ml). The adsorption time, latent period, rise period as well as the burst size of the isolated phages was also determined. Physiochemical characterization of the phages revealed that the phages were stable from 4°C-50 °C, a pH range of 4-9 and except RSP1; all other phages were stable 1% and 5% chloroform. Morphological classification using TEM revealed that all the phages had an icosahedral head with a very short non-contractile tail indicating that they may belong to either Podoviridae and/or Autographiviridae family of order Caudovirales. From the lysis dynamics curves of the individual phages, 3 phage cocktails were formed and cocktail-3 having all the seven phages gave the best results. Study on host range of the phages stated that all the phages were multi strain specific in nature and phage RSP4 had the highest host range. In vitro suppression of *R. solanacearum* in soil using phage cocktail-3 revealed that the cocktail was effective in managing *R. solanacearum* population in soil when used as a prophylactic manner. Finally, from the study on long term viability of phages at different storage temperatures it can be recommended that these seven phages could be stored in glycerol stocks at -45 °C or - 20 °C and in SM buffer in +4 °C without losing viability for a year. Keywords: Bacteriophage, *Ralstonia solanacearum*, bacterial wilt, phage therapy.

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## **Comparative assessment of bacterial wilt incidence and nutrient status of potato grown in high altitudes treated with microbe based bioformulations**

*Tsedar Wangmu*

In the present investigation, effort were made to evaluate the comparative efficacy of different microbe-based formulations against bacterial wilt incidence and nutrient status of potato grown in low and high altitudes. Roving survey was carried out for assessment of bacterial wilt incidence in four districts of Arunachal Pradesh and three districts of Assam. Bacterial wilt incidence in potato ranged from 13.80 to 15.62% in Jorhat, 13.25 to 16.76% in Golaghat and 9.34 to 16.26% in Bishwanath Chariali district of Assam. In Arunachal Pradesh, 6.4 to 13.8, 5.9 to 9.7, 3.5 to 9.7 and 2.8 to 8.3 per cent incidence of bacterial wilt of potato recorded in Tawang, West Kameng, Namsai and Lepa Rada district, respectively. Seven microbe based formulations viz., Bioveer, Biosona, Biometta, Biotime, Biogreen-5, Biofor-Pf, and Biogreen-L developed by Department of Plant Pathology, AAU, Jorhat, were screened in pots to find out the most effective formulation against *Ralstonia solanacearum*, the bacterial wilt pathogen. All the formulations showed a varying degree of efficacy against the pathogen. However, the formulations Biogreen-5, Biofor-Pf and Biotime showed highest efficacy with 57.12, 54.26 and 51.40 per cent reduction of bacterial wilt, respectively. These three formulations also showed better growth attributing characters in comparison to the other formulations. Based on comparative higher efficacy against *R. solanacearum* and better plant growth attributing characters, Biogreen-5, Biotime and Biofor-Pf were selected for field evaluation in management of bacterial wilt of potato under low (Jorhat 116m MSL) and high (Tawang, AP 3048m MSL) altitude situations. Under low altitude (Jorhat) Biogreen-5 could give maximum protection (44.60%) against bacterial wilt with minimum (25.56%) incidence of the disease followed by Biofor-Pf with 37.40% protection. Maximum plant height (50.01cm), number of shoots (6.18) and the dry weight of haulm (261.61kg/ha) was recorded by combined tuber treatment (6g /kg tuber) and soil application of Biogreen -5 (enriched compost @ 2t/ha). Significant increase in

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macro-nutrient (N, P, and K) and micro-nutrient (Zn and Mn) availabilities in soil were observed in bio-formulation treated plots. The highest tuber yield (11.32 t/ha) was observed in Biogreen -5 followed by Biofor-Pf with a tuber yield of 10.79 t/ha. These two bio-formulations recorded 39.13 and 36.14 per cent increase of tuber yield over untreated control. The B:C ratio calculated for these two treatments are 2.33 and 1.41, respectively. Under high altitude (Tawang), Biogreen-5 gave maximum protection (54.90%) against the disease with a minimum wilt incidence (15.27%). The bio-formulation Biofor-Pf recorded 48.04% protection against the disease. Combined application of Biogreen -5 (Tuber treatment @ 6g/kg and soil application @ 2t/ha) recorded highest plant height (37.57cm), number of shoots (4.59) and the dry weight of haulm (175.69kg/ha). This treatment also recorded highest tuber yield (8.68t/ha) with a B:C ratio of 1.12.

# **Effect of long-term integrated nutrient management on dynamics of phosphorus in rice-rice system**

*Kondareddy A N*

The present work was carried out during 2019-2021 with some selected treatments of the long-term Permanent Plot Experiment on Integrated Nutrient Supply System in Cereal Based Cropping Sequence laid out during 1987-1988 under All India Coordinated Research Project on Integrated Farming System at ICR farm, Assam Agricultural University (AAU), Jorhat. The experiment was laid out in a randomized block design replicating 4 times with 9 treatment combinations viz., T1 : no fertilizer, no organic manure (control), T2 : 50% RDF (chemical), T3 : 100% RDF (chemical), T4 : 50% RDF (chemical) + FYM @ 2.5 t/ha for winter rice and 100% RDF (chemical) for autumn rice, T5 : 75% RDF (chemical) + FYM @ 1.25 t/ha for winter rice and 75% RDF (chemical) for autumn rice, T6 : 50% RDF (chemical) + rice stubble @ 3.0 t/ha for winter rice and 100% RDF (chemical) for autumn rice, T7 : 75% RDF (chemical) + rice stubble @ 1.5 t/ha for winter rice and 75% RDF (chemical) for autumn rice, T8 : 50% RDF (chemical) + Azolla @ 0.5 t/ha for winter rice and 100% RDF (chemical) for autumn rice, T9 : 75% RDF (chemical) + Azolla @ 0.25 t/ha for winter rice and 75% RDF (chemical) for autumn rice. Phosphorus dynamics at three (3) different growth stages viz., tillering, flowering and harvesting and at two soil depths viz. 0-15 & 15-30 cm was determined in rice-rice system. After two crop cycles partial balance of phosphorus was calculated within 0-30 cm soil depth. Correlations of different P fractions with soil properties, crop P uptake and yield of rice were also determined at the end of the cropping sequence. Contribution of different P fractions to yield of rice-rice system was determined by Path Analysis. Results revealed that physical and chemical properties of the soils improved significantly under INM treatments over control due to higher organic carbon content of soil resulting from the addition of organics along with chemical fertilizers, after 33 cycles of rice-rice sequence. Available P of the soils were significantly higher in 50% RDF + FYM 2.5 t/ha fertilized plot followed by 100% RDF (T4) at the three growth stages and at two soil depths (0- 15 & 15-30 cm) in both winter and autumn rice, respectively. The available P was increased by 134.61 and 123.54 % at

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0-15 and 15-30 cm depth respectively, in the treatment T4 over control (T1). The increase of Available P in T4 was 6.5 kg ha<sup>-1</sup> over initial (10.05 kg ha<sup>-1</sup>). Similarly, irrespective of growth stage and depth of soil, the saloid-P was found significantly higher in treatment T4 in both winter and autumn rice. The content of saloid-P was increasing from tillering to harvest. Aluminum phosphorus (Al-P) and iron phosphorus (Fe-P) were found significantly higher in unfertilized control treatment compared to all other treatments at three growth stages and at two soil depths (0-15 & 15-30 cm) in both winter and autumn rice. This might be due to enhanced the process of P fixation with abundantly available Al & Fe oxides in acid soil. In the treatment T4 Al-P and Fe-P were found 20.22% & 29.76% at 0-15 cm and 19.25% & 30.40% at 15-30 cm, respectively lower than the control after 33 cycles of rice-rice sequence. Reductant soluble phosphorus (RS-P) and occluded phosphorus (Occluded-P) were found significantly higher in treatment T4 at three growth stages and at two soil depths (0-15 & 15-30 cm) in both winter and autumn rice. The RS-P in T4 at tillering stage 10.01 and 10.79 kg/ha (0-15 cm) and 7.91 and 8.73 kg/ha (15-30 cm) in winter and autumn rice, respectively and was increasing after harvest of winter rice and autumn rice [10.28 and 11.26 kg/ha (0-15 cm) and 8.31 and 9.24 kg/ha (15-30 cm), respectively]. Similarly, Occluded-P was found the highest in T4 at tillering stage in both winter and autumn rice. It was 6.74 and 7.07 kg/ha (0-15 cm) and 5.22 and 5.72 kg/ha (15-30 cm) in winter and autumn rice, respectively and after harvest gradually increased to 6.85 and 7.33 kg/ha (0-15 cm) and 5.54 and 6.05 kg/ha (15-30 cm), respectively. Calcium phosphorus (Ca-P) was found significantly higher in INM treatments at three growth stages in two soil depths (0-15 & 15-30 cm) in case of both winter and autumn rice might be due to masking effect of organic matter that forms a cover on sesquioxides which makes them inactive. The organic phosphorus (Organic-P) and total phosphorus (Total-P) were found significantly higher in treatment T4 after harvest in two soil depths (0-15 & 15-30 cm) in both winter and autumn rice. Organic-P and Total-P were the highest in T4 in winter rice (128.78 and 126.42 kg/ha at 0-15 cm and 286.52 and 289.67 kg/ha at 0-15 cm) and autumn rice (129.09 and 131.43 kg/ha at 15-30 cm and 279.63 and 285.62 kg/ha at 15-30 cm). The organic-P & total-P content of soils as affected by the different INM treatments under rice-rice cropping system varied in the order of T4> T6> T8> T5> T7> T9> T3 > T2> T1. The soil partial phosphorus balance (PPB) of rice-rice system revealed that, with application of inorganic fertilizer (50% RDF) and with no fertilizer application (control) resulted in a negative PPB, while in 100% RDF resulted positive and highest PPB (11.14 kg/ha). However, application of organics (FYM or Rice stubble or Azolla) with chemicals found to be positive PPB and the highest PPB (1.07 kg/ha) was found in 50% RDF + FYM @ 2.5 t ha<sup>-1</sup> in winter rice and followed by 100% RDF in autumn rice. All the fractions of phosphorus were significantly and positively correlated with each other, pH, soil organic carbon, microbial biomass carbon, av. N, av. K, P uptake and yield except Al-P and Fe-P in rice-rice sequence. Thus, from the findings of present investigation conclusion can be drawn that application of 50% RDF + FYM @ 2.5 t ha<sup>-1</sup> in winter rice (cv. Ranjit) followed by

100% RDF (chemical) in autumn rice (cv. Disang) can be considered as the best INM practice for rice-rice system of Assam as it is environmentally sound, economically viable, contributing to sustainable soil health and productivity hence farmers friendly.

## **Assessment of Soil Erodibility and Productivity Potential for Winter Rice in a Transect of Jiyadhhol River Basin, Assam**

*Rituparna Saikia*

Soil erosion is a major environmental problem in developing countries like India, where agriculture is the main economic activity of the people. The present investigation aims to assess the soil erodibility and productivity potential for winter rice in a transect of Jiyadhhol river basin with respect to landform characteristics, morphometry, erosion hazard and potential for growing rice. The study area extends E longitudes, covering° E to 94.540° N latitudes and 94.294° N to 27.574° from 27.335 an area of 47,389.13 ha. Based on topographical variation in satellite data, four distinct landform units were delineated which includes: piedmont plain (9,097.69 ha), upper alluvial plain (9,594.9 ha) lower alluvial plain (13,706.57 ha) and flood plain (14,977.0 ha). The drainage map identified the transect as fifth order drainage basin with higher numbers of first order streams making it vulnerable to erosion hazard. There was significant variation of slope, physiographic structure and infiltration capacity across the basin. The mean bifurcation ratio (3.56) indicated that the basin is underlined by uniform materials and streams are branched systematically. Relatively lower value of 'Rho' coefficient indicated meager capacity of hydrologic storage during the period of floods that could leads to higher runoff. The relatively higher drainage density (0.91 km km-2 ) could be the results of impermeable subsoil material, sparse vegetation and high relief. The drainage intensity (0.43) indicated that the basin area was highly susceptible to flooding and gully erosion. The elongation ratio, circulatory ratio, form factor ratio and shape factor indicated that the shape of the studied transect was nearly circular. Such basins are highly erosion prone as compared to elongated basins. A total of 170 no of geo-referenced surface (upto 30 cm) soil samples were collected for analyzing soil physico-chemical, hydro-physical and fertility related parameters. There was a decreasing trend in total sand and very fine sand content in soils from piedmont plain toward flood plain. Whereas, silt and clay content increases from piedmont plain towards flood plain. The textural properties of studied soils varied from loamy sand to clay loam; sandy loam was the dominant texture. The structural properties of studied

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**Department: Soil Science**

**Major Adviser: Dr. D. K. Patgiri**

soils varied from sub angular blocky to massive. Among the different landform units the highest bulk density was recorded in the piedmont plain soils (Mean 1.5 Mg m<sup>-3</sup> ). The pH in the studied soils varied from very strongly acidic to slightly acidic (4.69 to 6.47). The total area of 69.4% was strongly acidic and 4.3% of the area was very strongly acidic. Cation exchange capacity, exchange capacity of clay, apparent cation exchange capacity and exchangeable cations were higher in flood plain soil which may be linked to corresponding higher clay and soil organic matter content. Likewise, the status of soil organic carbon, available nitrogen, available phosphorus and available potassium was high in soils of flood plain. Soils of flood plain exhibited higher macro-aggregation owing to higher clay and soil organic matter. However, piedmont plain soils exhibited higher microaggregate content. Soil erodibility indices viz., silt clay ratio, clay ratio, modified clay 6 ratio, dispersion ratio, erosion ratio showed that piedmont plain soils are more susceptible to soil erosion. The geospatial assessment of their variability clearly prioritizes the areas with higher erosion susceptibility, where, suitable management practices may be undertaken to increase soil productivity. The findings from erodibility indices were further corroborated by soil loss assessment by universal soil loss equation, which revealed that 38.5 percent area was under severe soil loss. The areas in higher elevation were under higher soil loss and vice versa. The piedmont soils, affected by very severe erosion hazard (average soil loss of 34.80 t ha<sup>-1</sup> yr<sup>-1</sup> ) which might be due to dominating factors like higher relief, steep slope, lighter texture and weaker structure, hence need immediate adoption of conservation measures. The soil productivity and potentiality index was evaluated as per the procedure suggested by Riquir et al. (1970). Piedmont plain soils having productivity index values from 12.1 to 35.1 (Mean 23.0) were rated as poor to average classes. The acidic pH, low organic matter, low base saturation and coarse texture being the major limiting factors for crop production. The piedmont plain (Mean 2.01) and upper alluvial plain (Mean 1.79) soils had more coefficient of improvement as compared to lower alluvial plain (Mean 1.60) and flood plain (Mean 1.57) soils. Majority of the piedmont plain soils are found to be unsuitable for growing Sali, Ahu and Boro rice and the corresponding yield of Sali rice was also quite low. Therefore alternate crops may be grown with suitable irrigation facilities. The negative relationship of soil loss with rice yield, productivity, potentiality and suitability indicated that greater soil loss leads to decrease in productivity of soils. The potential productivity index value was higher for piedmont plain soils. Significant positive relationship was obtained between normalized difference vegetation index during peak vegetative stage with yield, soil organic matter, mean soil site suitability index for Sali rice and crop yield index in the first year of study. Summarizing above results it may be concluded that the Jiyadhhol river basin transect is a fifth order watershed with high vulnerability to soil erosion. Majority of the soils of the study area have high soil erodibility owing to poor soil physical properties as well as topographical position. Geospatial assessment of soil loss has clearly delineated areas with severe soil loss, hence, based on this suitable conservation measures may be effectively adopted. Moreover, while formulating site specific crop management plan GIS based thematic

maps of soil properties and erodibility may be taken as ready reckoner to augment productivity, profitability and sustainability of cropping systems in the area.

## **Assessment of zinc use efficiency in maize-maize cropping sequence**

*Sanjib Ranjan Borah*

A field experiment was conducted at Krishi Vigyan Kendra, Jorhat farm, Kaliapani, Teok, Assam Agricultural University during 2018-19 and 2019-20 to study the influence of zinc fertilization on zinc fractions in soil, its relationship with important soil properties, yield, nutrient uptake and zinc use efficiency in maize-maize cropping sequence. The experiment was laid down in a randomized block design (RBD) with twelve treatments consisted of zinc applied as soil with or without foliar application through zinc sulphate and zinc oxide nano particle (ZnO NPs). Distribution of different zinc fractions in soil were assessed after harvest of each crop in the sequence. Perusal of experimental findings revealed that zinc fertilization had a significant influence on different zinc fractions in soil during both the years under investigation. The study revealed that among the zinc treatments, soil application of Zn @ 3.75 kg ha<sup>-1</sup> in combination with foliar application of 500 ppm ZnO NPs exhibited the highest water soluble plus exchangeable-Zn content of 1.10 mg kg<sup>-1</sup> in soil. The highest concentration of complexed-Zn (2.95 mg kg<sup>-1</sup>), amorphous sesquioxide-bound Zn (4.11 mg kg<sup>-1</sup>), crystalline sesquioxide-bound-Zn (3.76 mg kg<sup>-1</sup>), residual-Zn (125.65 mg kg<sup>-1</sup>) and total-Zn (137.33 mg kg<sup>-1</sup>) were recorded in the treatment receiving soil application of Zn @ 7.5 kg ha<sup>-1</sup>. Among the zinc fractions studied, the concentration and percent contribution of water soluble plus exchangeable-Zn to total-Zn was the lowest while residual-Zn fraction contributed the highest to the total soil zinc pool. Path coefficient analysis showed that the water soluble plus exchangeable-Zn had the highest contribution towards the DTPA extractable-Zn in soil. The distribution of different zinc fractions at post-harvest soil was found in the following order: water soluble plus exchangeable-Zn < complexed-Zn < crystalline sesquioxide bound-Zn < amorphous sesquioxide bound-Zn < residual-Zn. All the fractions of zinc were found to be significantly and positively correlation with each other indicating existence of dynamic equilibrium of zinc in soil. Zinc fertilization exerted a significant influence on available nutrient status of soil. The highest available nitrogen content of 182.50 kg ha<sup>-1</sup> was found in the treatment receiving soil application of Zn @ 3.75 kg ha<sup>-1</sup> in combination with foliar application of 500 ppm ZnO NPs. The available phosphorus content in soil

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**Abstract of Ph. D. thesis**

**Department: Soil Science**

**Major Adviser: Dr. Anjali Basumatary**

was decreased with zinc fertilization and thus, soil application of Zn @ 7.5 kg ha<sup>-1</sup> recorded the lowest available phosphorus content of 19.45 kg ha<sup>-1</sup>, while the highest phosphorus content of 23.74 kg ha<sup>-1</sup> was recorded in the control. However, no significant influence of zinc fertilization on available potassium, exchangeable calcium and exchangeable magnesium content in the post-harvest soils were observed. The highest available sulphur content of 25.50 kg ha<sup>-1</sup> was registered in the treatment receiving soil application of Zn @ 7.5 kg ha<sup>-1</sup>. In respect of content of available micronutrients in soil, the DTPA extractable Fe, Cu and Mn content in soil were decreased with Zn fertilization and the highest content of DTPA extractable Fe (37.38 mg kg<sup>-1</sup>), Cu (0.42 mg kg<sup>-1</sup>) and Mn (9.26 mg kg<sup>-1</sup>) in soil was recorded in the control treatment, whereas, the lowest content was found in the treatment receiving Zn @ 7.5 kg ha<sup>-1</sup>. Application of 500 ppm ZnO NPs as foliar with soil application of Zn @ 3.75 kg ha<sup>-1</sup> recorded significantly the highest DTPA extractable Zn content of 1.33 mg kg<sup>-1</sup> in the post harvest soil. The study also revealed that zinc fertilization significantly influenced the grain and stover yield of maize. Perusal of pooled data indicated that among the zinc treatments, combined application of 500 ppm ZnO NPs as foliar with soil application of Zn @ 1.25 kg ha<sup>-1</sup> registered the highest grain yield (65.04 q ha<sup>-1</sup>), stover yield (80.39 q ha<sup>-1</sup>) and harvest index (46.95%) in maize- maize sequence. Zinc fertilization exhibited a significant influence on uptake of major as well as micronutrients by maize. The highest uptake of nitrogen, potassium, calcium and magnesium by maize crops were recorded in the treatment receiving soil application of Zn @ 1.25 kg ha<sup>-1</sup> in combination with 500 ppm ZnO NPs as foliar. The highest uptake of phosphorus by grain (14.81 kg ha<sup>-1</sup>) and stover (18.22 kg ha<sup>-1</sup>) was recorded in the treatment receiving 500 ppm ZnO NPs as foliar whereas, the highest sulphur uptake by grain (9.95 kg ha<sup>-1</sup>) and stover (11.72 kg ha<sup>-1</sup>) was found in the treatment receiving combined application of 500 ppm ZnO NPs as foliar with soil application of Zn @ 3.75 kg ha<sup>-1</sup>. Among the micronutrients, the highest uptake of Fe (214.56 g ha<sup>-1</sup>), Cu (31.99 g ha<sup>-1</sup>), Mn (56.33 g ha<sup>-1</sup>) and Zn (156.36 g ha<sup>-1</sup>) by maize grain was found in the treatment receiving combined application of 500 ppm ZnO NPs as foliar with soil application of Zn @ 1.25 kg ha<sup>-1</sup>. The highest uptake of Fe (846.24 g ha<sup>-1</sup>), Cu (45.99 g ha<sup>-1</sup>), Mn (248.57 g ha<sup>-1</sup>) and Zn (279.58 g ha<sup>-1</sup>) by maize stover was also found in the same treatment. Analysis of pooled data indicated that method of zinc fertilization had significant influence on zinc use efficiency by maize. The highest agronomic efficiency (2382.51 kg kg<sup>-1</sup>), apparent recovery efficiency (36.88%), zinc utilization efficiency (4067.44 kg kg<sup>-1</sup>) and partial factor productivity (16913.19 kg kg<sup>-1</sup>) was recorded in the treatment receiving foliar application of 500 ppm ZnO NPs. The highest physiological efficiency (12816.13 kg kg<sup>-1</sup>), agro physiological efficiency (7567.77 kg kg<sup>-1</sup>) was recorded in the treatment receiving combined application of 500 ppm ZnO NPs as foliar with soil application of Zn @ 1.25 kg ha<sup>-1</sup>. Cost benefit analysis revealed that among different treatment combinations, the highest gross return (Rs. 1,17,072.00), net return (Rs. 82,773.00) and highest B-C ratio (2.41) was registered in the treatment receiving 500 ppm ZnO NPs as foliar in combination with soil application of Zn @ 1.25

kg ha<sup>-1</sup> . Considering improvement of crop yield and economic return, combined application of 500 ppm ZnO NPs as foliar with soil application of Zn @ 1.25 kg ha<sup>-1</sup> was found to be superior over other treatments.



# **Assessment of Soil and Groundwater Quality as influenced by continuous monoculture of Tea (*Camellia sinensis*) in the Upper Brahmaputra Valley Zone (UBVZ) of Assam**

*Shyamal Kumar Phukon*

Tea (*Camellia sinensis*) is one of the most important perennial cash crops of Assam used for domestic consumption and export. Assam produces 55% of the tea produced in India and 1/6th of the tea produced in the world. Most of the small tea gardens are confined to Upper Brahmaputra Valley Zone (UBVZ). Tea crop is cultivated since years and predictions are made that due to prolonged monoculture it may be deteriorating soil health over and depletion of nutrients or nutrient imbalance compounded by poor physical, chemical and biological conditions of the soils appear to contribute significantly. So the present investigation was undertaken to find out the soil and water quality of the tea gardens in five districts viz. Golaghat, Jorhat, Sivsagar, Dibrugarh and Tinsukia with a special reference to the age groups (0-5, 5-30, 30-45, >45) years of cultivation in identifying the key quality indicators for assessing the effect of continuous monoculture of tea on soil and water quality index and to study the changes in soil and water quality index and to see the concentration of Aluminium and Fluoride in tea plant and their correlation with yield. Through identification of Minimum Data Set (MDS) for soil and water quality with principal component analyses, the critical soil quality indicators were identified in continuous tea cultivation in reference to the age. In Golaghat district the SQI was found to be 17.29, 16.68, 14.46 and 12.50 for the age groups of 0-5, 5-30, 30-45, >45 years of continuous tea cultivation with MDS AWC, pH, OM, MBC, Fe, Ca, MWD and Avl S; Avl P2O5, MBC, Avl K2O, Fe, Zn, Avl S, OM and sand; Avl K2O, Avl P2O5, OM, DHG, Avl S and clay; Avl K2O, Fe, Avl P2O5, WHC, DHG, EC and clay respectively. Similarly, in Jorhat, Sivsagar, Dibrugarh and Tinsukia the SQI values were 16.41, 14.08, 10.57, 10.32; 14.01, 12.71, 11.25, 10.97; 13.57, 12.59, 11.97, 11.62; 11.31, 10.22, 10.13, 9.01 under 0-5, 5-30, 30-45, >45 years of continuous cultivation, respectively with MDS of F, Avl P2O5, OM, pH, MWD, MBC, Ex Al, B; B, Ca, pH, EC, MWD, MBC, Ex Al; OM, Avl K2O, Ca, Ex Al, Avl N, Av P2O5, Avl S; Avl N, WHC, pH, MBC, Zn, Ex Al, Avl S

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**Abstract of Ph. D. thesis**

**Department: Tea Husbandry and Technology**

**Major Adviser: Dr. R.P. Bhuyan**

and B in Jorhat, Zn, DHG, AWC, pH, Avl S, Avl K<sub>2</sub>O, Ex Al, Avl N; Ex Al, B, Avl N, BD, clay, EC, WHC; MWD, Fe, pH, Avl K<sub>2</sub>O, Avl P<sub>2</sub>O<sub>5</sub>, OM, B, PD, Ex Al; Avl K<sub>2</sub>O, Avl S, Fe, Ex Al, F, WHC, Ca and EC in Sivasagar district, Ex Al, pH, F, Avl K<sub>2</sub>O, DHG; AWC, Zn, pH, Avl N; Zn, B, MWD, Avl P<sub>2</sub>O<sub>5</sub>, Avl S, Fe, BD, Ex Al; Zn, DHG, AWC, Avl P<sub>2</sub>O<sub>5</sub> and silt in Dibrugarh, Zn, Avl S, Ex Al, OM, WHC; Avl S, Avl N, Zn, Avl P<sub>2</sub>O<sub>5</sub>; OM, Avl N, MBC, pH, EC, Avl P<sub>2</sub>O<sub>5</sub>; MBC, pH, Ca, OM, Zn, Avl N, Avl K<sub>2</sub>O and DHG in Tinsukia District. Among these, the most sensitive indicators of soil quality were pH, Avl N, Avl P<sub>2</sub>O<sub>5</sub>, Avl K<sub>2</sub>O, OM, Zn, Ex Al and Avl S which contributes the most towards SQI in all the districts. Water Quality Index (WQI) determines the quality of water and the best quality is being found in Dibrugarh (54.37) followed by Tinsukia (44.40), Sivasagar (33.65), Golaghat (26.24) and Jorhat (19.30) respectively with MDS of HCO<sub>3</sub><sup>-</sup>, Ca, EC, TDS and F<sup>-</sup>; F<sup>-</sup>, Mg, NO<sub>3</sub><sup>-</sup>, HCO<sub>3</sub><sup>-</sup> and TDS; EC, F<sup>-</sup>, NO<sub>3</sub><sup>-</sup> and As; Ca, pH, HCO<sub>3</sub><sup>-</sup> and TDS; TDS, HCO<sub>3</sub><sup>-</sup>, pH, SO<sub>4</sub><sup>2-</sup>, NO<sub>3</sub><sup>-</sup> and Frespectively. Most of the age group of the districts of the present study revealed no significant correlation of tea yield with F and Al concentration indicating that F and Al concentration had no impact on tea yield. Though average Al and F concentration was found to increase with the increase in age of cultivation irrespective of cultivated area under the Upper Brahmaputra Valley Zone of Assam. Moreover among all the age groups of the districts, no significant correlation of tea yield with stem girth and bush spread were observed. Based on the secondary data, tea average yield was found to be highest in Tinsukia followed by Dibrugarh, Sivsagar, Jorhat and Golaghat under all the age groups.

## **Ph.D (Veterinary Science)**

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- **Animal Biotechnology**
- **Animal Genetics and Breeding**
  - **Animal Nutrition**
- **Animal Reproduction, Gynaecology and Obstetrics**
  - **Anatomy and Histology**
    - **Biochemistry**
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  - **Epidemiology and Preventive Medicine**
    - **Extension Education**
      - **Microbiology**
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      - **Pathology**
- **Pharmacology & Toxicology & Jurisprudence**
  - **Physiology**
  - **Public Health**
  - **Surgery and Radiology**
- **Livestock Production and Management**
  - **Livestock Products Technology**
    - **Poultry Science**

## **Phenotypic Characterization and Polymorphism Study of Prolactin Gene in Native Geese of Assam**

*Ankita Gogoi*

Data pertaining to 1015 native geese of Assam were considered for morphometric characteristics, productive and reproductive performances, egg quality and carcass traits, along with screening of polymorphisms in 5'flanking region of Prolactin gene. Two plumage colours, cinnamon (62.38%) and white (37.62%) were seen. Bill colour was observed to be black (49.08%), orange (35.33%), yellow (13.24%) and mixture of black and orange (2.35%). The skin was 100% white. Shank and feet colour were orange (75.32%), yellow (21.67%) and mixture of black and orange colour (3.01%). Black (60.14%), brown (28.49%) and blue (11.37%) eye colour was seen. The overall LSM  $\pm$  SE for body weights at hatching, 4 week, 8 week, 6 month, 8 month, 12 month of age were 89.85 $\pm$ 0.11, 66.89 $\pm$ 1.21, 1761.90 $\pm$ 2.08, 3305.42 $\pm$ 4.63, 3575.80 $\pm$ 10.61 and 3804.84 $\pm$ 3.91 g, respectively. The overall mean (cm) for bill length, bill width, knob diameter (at 12 months of age), head length, head width, neck length, neck girth, breast length, keel length, body length, body circumference, shank length and wingspan (3 to 6, 8 to 10 and 12 months of age) at the respective ages were 5.31  $\pm$  0.018, 6.24  $\pm$  0.01, 7.24  $\pm$  0.012, 8.42  $\pm$  0.014; 1.46  $\pm$  0.010, 1.95  $\pm$  0.008, 2.19  $\pm$  0.009, 2.45  $\pm$  0.009; 2.34  $\pm$  0.006; 5.42  $\pm$  0.019, 6.70  $\pm$  0.018, 8.31  $\pm$  0.019, 10.26  $\pm$  0.018; 2.44  $\pm$  0.009, 2.80  $\pm$  0.011, 3.03  $\pm$  0.010, 3.26  $\pm$  0.012; 14.13  $\pm$  0.031, 16.00  $\pm$  0.032, 17.80  $\pm$  0.026, 21.74  $\pm$  0.027; 2.17  $\pm$  0.012, 4.12  $\pm$  0.013, 6.28  $\pm$  0.011, 10.19  $\pm$  0.019; 7.95  $\pm$  0.022, 15.73  $\pm$  0.044, 21.42  $\pm$  0.023, 29.93  $\pm$  0.022; 10.93  $\pm$  0.024, 12.62  $\pm$  0.023, 14.34  $\pm$  0.025; 35.89  $\pm$  0.049, 39.82  $\pm$  0.040, 42.36  $\pm$  0.043, 48.21  $\pm$  0.037; 33.03  $\pm$  0.033, 43.74  $\pm$  0.06, 45.59  $\pm$  0.033, 49.92  $\pm$  0.029; 5.23  $\pm$  0.015, 6.10  $\pm$  0.016, 7.30  $\pm$  0.015, 8.36  $\pm$  0.015 and 89.89  $\pm$  0.038, 101.54  $\pm$  0.038 and 114.12  $\pm$  0.037, respectively. Significant effects ( $P < 0.01$ ) of district and sex of bird on body weight and morphometric traits were observed. Age at first lay, annual egg production, clutch size and clutch interval were 323.02 $\pm$ 0.302 days, 21.51 $\pm$ 0.180 numbers, 9.87 $\pm$ 0.098 numbers and 64.48 $\pm$ 0.655 days, respectively. Two laying cycles, viz., September to October and December to February were observed. Egg weight, shell weight, shell thickness, shape index and specific gravity were 117.00 $\pm$ 1.395 g, 14.19 $\pm$ 0.225 g, 0.54 $\pm$ 0.006 mm, 72.22 $\pm$ 0.283 % and 1.09 $\pm$ 0.001, respectively. Albumen Index, Haugh Unit, Yolk Index

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**Abstract of Ph.D. thesis**

**Department: Animal Genetics and Breeding**

**Major Adviser: Dr. Bula Das**

and yolk weight were  $0.06 \pm 0.001$ ,  $59.79 \pm 0.726$ ,  $0.34 \pm 0.007$  and  $61.98 \pm 1.045$ , respectively. Age at slaughter (days), pre-slaughter weight (g), shrinkage (%), dressing percentage (%), evisceration loss (%) and ready to cook yield (%) in gander were  $411.40 \pm 4.26$ ,  $4192.80 \pm 69.87$ ,  $4.36 \pm 0.05$ ,  $67.10 \pm 1.14$ ,  $7.58 \pm 0.58$  and  $70.43 \pm 1.05$ , respectively. The corresponding values in geese were  $338.00 \pm 21.48$ ,  $3878.40 \pm 36.06$ ,  $4.76 \pm 0.32$ ,  $66.11 \pm 1.01$ ,  $7.02 \pm 0.73$  and  $70.28 \pm 1.24$ . In gander, yield of cut up parts on live weight (%) were  $17.62 \pm 0.19$ ,  $7.68 \pm 0.14$ ,  $6.58 \pm 0.10$ ,  $13.56 \pm 1.29$ ,  $4.62 \pm 0.12$  and  $8.05 \pm 0.21$  for breast, drumstick, thigh, back, neck and wings respectively. The corresponding values on dressed weight (%) were  $27.49 \pm 0.56$ ,  $11.98 \pm 0.29$ ,  $10.26 \pm 0.13$ ,  $21.01 \pm 1.66$ ,  $7.21 \pm 0.23$  and  $12.55 \pm 0.25$ , respectively. In geese, cut up parts yield to live weight (%) were  $17.58 \pm 0.28$ ,  $6.74 \pm 0.14$ ,  $6.71 \pm 0.10$ ,  $12.40 \pm 0.50$ ,  $4.35 \pm 0.16$  and  $7.87 \pm 0.33$  for breast, drumstick, thigh, back, neck and wings, respectively. The corresponding values as per dressed weight (%) were  $27.94 \pm 0.42$ ,  $10.71 \pm 0.19$ ,  $10.67 \pm 0.16$ ,  $19.67 \pm 0.43$ ,  $6.93 \pm 0.33$  and  $12.48 \pm 0.41$ , respectively. Meat to bone ratio of  $2.05 \pm 0.01$  was found in both the sexes. 100 percent broody behavior observed. Fertility and hatchability (TES) were  $91.38 \pm 6.83$  and  $86.50 \pm 7.59\%$ . Mortality rate were 22.58, 15.24 and 11.72 at 0 to 1, 1 to 8 and 8 to 20 weeks. Screening for polymorphism in 5'-flanking region of *PRL* revealed transversion of G to C at location 117 and transition of C to T at location 182. The native geese attained much higher body weight at 6 months and 12 months of age compared to other poultry species. Various studies may be undertaken to genetically characterize the goose populations and association studies of genes with production traits may be conducted. Geese have promising role as alternate species for backyard poultry meat production. The detailed study would help in development of breed descriptors and baseline reference for future studies.

# Genetic Studies on The Performance of HD-K75 Pigs

*Jyotishree Bayan*

Pig farming in India is primarily a small scale unorganized rural activity and is an integral part of diversified agriculture particularly in the tribal belt of the country and have been contributing to improve the livelihood of poor and socially weaker section of the society including the tribal people of India. Pig farming in Assam is rapidly gaining momentum in recent years as the farmers are finding it a profitable enterprise.

The present investigation was carried out on HD-K75 pigs (75% Hampshire inheritance and 25 % indigenous inheritance) that are bred and maintained in the All India Coordinated Research Project (AICRP) on pigs, ICAR, located at College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati-781022. The data were collected and compiled from the progenies of 44 sires and 114 dams maintained over a period of 6 years from 2012 to 2018.

The objective of the investigation were to study some important traits of growth and reproduction and the effect of various non-genetic factors influencing these traits, determine heritability, genetic correlation and phenotypic correlation of some important growth and reproduction traits, to construct linear, partial and multiple regression equations and to predict adult body weights based on early body weights.

Traits included in the study were body weights at birth, weaning, 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup>, 6<sup>th</sup> and 8<sup>th</sup> months of ages, and daily body weight gains during pre-weaning (birth to weaning) and post-weaning periods (from weaning to 4<sup>th</sup>, 6<sup>th</sup> and 8<sup>th</sup> month of ages), age at sexual maturity, gestation period, farrowing interval, litter size at birth, litter weight at birth, litter size at weaning and litter weight at weaning.

The overall mean body weight in HD-K75 pigs at birth, 1 month, weaning, 2 months, 3 months, 4 months, 6 months and 8 months of age were  $1.001 \pm 0.001$  kg,  $6.912 \pm 0.011$  kg,  $9.666 \pm 0.013$  kg,  $12.207 \pm 0.007$  kg,  $18.324 \pm 0.001$  kg,  $28.349 \pm 0.052$  kg,  $51.177 \pm 0.091$  kg and  $71.229 \pm 0.110$  kg respectively. The average daily body weight gains (ADG) in g during birth to weaning, weaning to 4<sup>th</sup> month, weaning to 6<sup>th</sup> month and weaning to 8<sup>th</sup> month of ages were  $206.299 \pm 0.311$ ,  $237.294 \pm 0.773$ ,  $299.541 \pm 0.700$  and  $311.206 \pm 0.557$  respectively. Least-squares analysis of variance revealed highly significant effect of season of birth, parity and sex on body weight at all

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**Abstract of Ph.D. thesis**

**Department: Animal Genetics and Breeding**

**Major Adviser: Dr. Galib Uz Zaman**

ages and daily body weight gains at various stages of growth. Piglets born during winter season had higher body weight at birth, 1 month, 42 days, whereas piglets born during post-monsoon season had higher body weight at 2 months, 3 months, 4 months and 6 months of age and piglets born during monsoon season had higher body weight at 8 months of age. Pre-weaning ADG was higher in piglets born during monsoon season and lowest in animals born during pre-monsoon season. The ADG during 42 days to 4<sup>th</sup> month and 42 days to 6<sup>th</sup> month were found to be higher in piglets born during post-monsoon season and lowest in piglets born during pre-monsoon season. Piglets born in second parity had higher body weight at 3 months, 4 months, 6 months and 8 months whereas piglets born in third parity had higher body weight at birth and 1 month and piglets born in first parity had higher body weight at weaning and 2 months of age. Significantly higher ADG was found during pre-weaning period of growth in animals born in first parity. Further, the ADG from 42 days to 4<sup>th</sup> month, 42 days to 6<sup>th</sup> month and 42 days to 8<sup>th</sup> months of age were found to be higher in animals born in second parity and revealed significant difference with the animals of first and third parities. Males showed higher body weight and higher ADG than females in all stages of growth. The  $h^2$  estimates for body weight and ADG at various stages of growth in the present study were moderate to high in most of the cases which indicated that the population under study possess good amount of additive genetic variance and there is scope of genetic improvement of the herd in terms of growth traits and ADG at various stages using adequate methods of selection by incorporating these estimates. The phenotypic correlations among body weights at various ages were moderate and positive in some cases and negative in some cases. The phenotypic correlations among ADG at various stages of growth were moderate and positive in some cases and negative in some cases. The genetic correlations among body weights at various ages of growth were low to high and positive in some cases and negative in some cases. The genetic correlations among ADG at various stages of growth were moderate and positive in some cases and negative in some cases.

The overall means for age at sexual maturity, gestation length and farrowing interval were found to be  $205.294 \pm 1.054$ ,  $112.70 \pm 0.119$  and  $216.781 \pm 2.565$  days respectively.

Effect of season of birth on age at sexual maturity was found to be non-significant as indicated by least square analysis of variance. Non-significant effect of season of birth and parity on gestation period was observed in the present study in HD-K75 pigs. Least-squares analysis of variance revealed significant difference between the various seasons under study in respect of farrowing interval. Sows that farrowed during post-monsoon season had significantly longer farrowing interval and differed significantly with other seasons and the shortest farrowing interval was observed in sows that farrowed during monsoon season. Least square analysis of variance revealed that the effect of parity on farrowing interval in the present study was non-significant.

The  $h^2$  estimates of age at sexual maturity, gestation length and farrowing interval for HD-K75 pigs was low to moderate in magnitude. The phenotypic correlation among the reproduction traits were found to be low and positive in most cases. The genetic correlation among the reproduction traits were found to be moderate and positive in most cases.

The overall means for litter size at birth, litter size at weaning, litter weight at birth and litter weight at weaning were found to be  $7.747 \pm 0.088$ ,  $7.556 \pm 0.093$  numbers and  $7.804 \pm 0.084$  and  $74.644 \pm 0.0886$  kg respectively.

Least-squares analysis of variance revealed significant effect of season of birth on litter size at birth, litter size at weaning, litter weight at birth and litter weight at weaning. Piglets born during pre-monsoon season showed highest litter size at birth and weaning. Piglets born during post-monsoon season and winter season showed highest litter weight at birth and litter weight at weaning. Further, litter size at birth, litter size at weaning, litter weight at birth and litter weight at weaning were found lowest during monsoon season. Least-squares analysis of variance revealed that parity had significant effect on litter size at birth, litter size at weaning, litter weight at birth and litter weight at weaning. Piglets born in third parity showed highest and piglets born in first parity showed lowest litter size at birth, litter size at weaning, litter weight at birth and litter weight at weaning respectively.

The  $h^2$  estimates of litter size at birth and litter size at weaning in HD-K75 pigs in the present study were found to be low in magnitude. The  $h^2$  estimates of litter weight at birth and litter weight at weaning were found to be medium in magnitude. The phenotypic correlations among the litter traits were found to be high and positive in most cases. The genetic correlations among the litter traits were found to be moderate to high and positive in most cases.

Prediction equations were developed using post-weaning body weights at 6 months ( $Y_1$ ) and 8 months ( $Y_2$ ) of ages as dependent variables based on pre-weaning body weights at birth ( $X_1$ ), 1 month ( $X_2$ ), 42 days ( $X_3$ ), 2 months ( $X_4$ ) and 3 months ( $X_5$ ) of age as independent variables in various combinations. For prediction of adult body weights on the basis of body weights at early ages in HD-K75 pigs, linear, partial and multiple regression equations were developed.

The linear regression equations for predicting body weights at 6 months of age had comparatively higher  $R^2$  values than 8 months of age in HD-K75 pigs, but were not found to be reliable as the  $R^2$  values were less than 60 %. The partial regression equations for predicting body weights at 8 months of age had comparatively higher  $R^2$  values than 6 months of age and were found to be more reliable. All the multiple regression equations developed to predict the adult body weight at 8 months of age can be reliably used when 3-5 independent variables are considered. Multiple regression equations developed to predict 8 month body weight showed highest reliability with  $R^2$  values ranging from 70.87 to 90.56 %. High  $R^2$  values indicates that the 8 month body weight can be predicted more efficiently than 6 month body weight. The multiple regression equations for predicting body weight at 8 months using 3 independent



variables *viz.* body weight at birth, 1 month and weaning showed high  $R^2$  value of 90.21 % which was found to be highly reliable and the best combination, though higher  $R^2$  values were obtained in multiple regression equations using 4 and 5 independent variables.

# Understanding The Physio-Biochemical Status of Anoestrus Crossbred Cows and Comparative Evaluation of Certain Treatment Regimes

*Biren Kumar Das*

A study was conducted on Large White Yorkshire (LWY) pigs to assess the effect of feeding banana pseudo-stem silage and mixed silage of banana pseudo-stem and Taro (*Colocasia esculenta*) fermented, anaerobically, with *Lactobacillus acidophilus* and *Enterococcus faecium*. Eighteen LWY piglets, average body weight  $15.097 \pm 0.71$  kg, were randomly divided into three groups (T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub>) in a completely randomised block design with 6 piglets in each group. Three experimental iso-nitrogenous and iso-caloric diets were prepared and fed in two phase feeding programme i.e. growing phase (up to 35 kg body weight) and finishing phase (above 35 kg body weight) as per BIS, 2001 where T<sub>1</sub> (control) group was fed basal diet without silage while T<sub>2</sub> and T<sub>3</sub> group received diet with 25 % replacement of cereal (maize) grain of the basal diet with banana pseudo-stem silage and mixed silage of banana pseudo-stem and Taro. During 180 days of feeding trial, the body weight changes of the LWY pigs in growing phase as well as finishing phase varied significantly ( $P < 0.01$ ) among the treatment groups. There was significant difference ( $P < 0.05$ ) in fortnightly dry matter intake of the experimental pigs in the growing phase. ADG (g/h/d) and FCE of the growing-finishing pigs in the growing phase were also found to be significant ( $P < 0.05$ ) among the experimental pigs. Digestibility of dry matter and other nutrients were studied by conducting digestibility trial in growing and finishing phase of the experimental pigs. In the growing phase digestibility coefficient of DM, CP, CF & EE differed significantly ( $P < 0.05$  &  $P < 0.01$ ) among the treatment groups, but digestibility coefficient of OM and NFE did not differ ( $P > 0.05$ ) among the treatment groups. In the finishing phase digestibility coefficient of DM, OM, CP, CF, EE and NFE did not differ ( $P > 0.05$ ) among the experimental groups. There was no significant ( $P > 0.05$ ) difference in biochemical parameters of SGPT, SGOT, glucose, total protein, cholesterol, HDL and LDL among the groups. The carcass traits like dressing percentage, back fat thickness, loin eye area, per cent weight of whole sale cuts of pork, edible and inedible offal were

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not affected ( $P>0.05$ ) by the partial replacement of cereal (maize) grain in the basal diet with silages. Drip loss (%), water holding capacity and pH of *Longissimus dorsi* muscle did not differ ( $P>0.05$ ) among the treatment groups. Per cent moisture, protein, fat and ash of the *Longissimus dorsi* muscle were also not affected ( $P>0.05$ ) by the partial replacement of cereal (maize) grain in the basal diet with silages. Analysis of variance of histo-morphological measures of villus height, crypt depth, villus height: crypt depth and average villus surface area of duodenum and jejunum showed that 25% replacement of cereal (maize) grain of the basal diet with silages did not have adverse effect ( $P>0.05$ ) in the experimental pigs. In economic analysis, the cost of feed per kg weight gain was found to be reduced ( $P<0.05$ ) in  $T_3$  group pigs compared to  $T_1$  (control) and  $T_2$  group pigs. It was concluded that 25 % substitution of cereal (maize) grain from the basal diet by mixed silage of banana pseudo-stem and Taro in growing-finishing LWY pigs had no adverse effect on growth performance, serum biochemical profile and carcass characteristics, and had reduced the cost of pig production.

**Key words:** Growing-finishing pigs, silage, serum bio-chemical parameters, carcass traits, histo-morphology of intestine

## **Effect of Feeding Protected Proteins on Milk Yield and Nutrient Utilization in Crossbred Cows**

*Sikhamoni Haloi*

An experiment was conducted to assess the effect of feeding protected proteins on milk yield, milk quality, nutrient utilization and cost of production in crossbred cows. Eighteen lactating crossbred cows of almost similar milk yield and parity were randomly divided into three groups of six animals each. Randomized block design (RBD) technique was followed for the study. Experimental cows were allotted to three dietary treatments (T0, T1 and T2). T0 was considered as control group and T1 and T2 as treatment groups. Feeding of roughage and concentrate mixture having soybean meal (untreated) was offered in T0 group; while concentrate mixture with heat treated and formaldehyde treated soybean meal was offered to T1 and T2 group, respectively. The feeding trial was conducted for a period of 120 days followed by digestibility trial of 5 days.

The average dry matter (DM) intake (kg/Day) was  $10.98 \pm 0.04$ ,  $11.05 \pm 0.05$  and  $11.02 \pm 0.05$  for T0, T1 and T2 groups, respectively and did not differ significantly among groups. The DM intake (kg) per 100 kg body weight was  $3.34 \pm 0.07$ ,  $3.40 \pm 0.07$  and  $3.35 \pm 0.05$  for T0, T1 and T2 group, respectively. The DM intakes (g) per kg W0.75 body size was  $141.92 \pm 2.21$ ,  $144.44 \pm 2.22$  and  $142.32 \pm 1.31$  for the corresponding groups. The DM intake per 100 kg body weight and per kg W0.75 body size did not differ significantly among groups. The percent digestibility of DM, CP were significantly higher in T1 and T2 group over T0 group, however digestibility of EE, CF, NFE, NDF and ADF did not differ significantly among groups. The average daily milk yield (kg/Day) was  $7.70 \pm 0.98$ ,  $9.01 \pm 0.14$  and  $8.93 \pm 0.14$  for the T0, T1 and T2 group, respectively which was significantly higher ( $P < 0.01$ ) in T1 and T2 group compared to T0 group. The average FCM yield (kg/Day) was  $8.12 \pm 0.16$ ,  $9.42 \pm 0.17$  and  $9.30 \pm 0.18$  in T0, T1 and T2 respectively which was significantly higher ( $P < 0.01$ ) in T1 and T2 group in comparison to T0 group. The milk parameters like fat, protein, lactose, total solid, solid not fat did not differ significantly among groups. The total serum protein (g/dl), albumin (g/dl) and albumin globulin ratio was significantly higher ( $P < 0.01$ ) in T1 and T2 group compare to T0 group. The creatinine (mg/dl) and globulin (g/dl) concentration of blood were significantly lower in ( $P < 0.01$ ) in T1 and T2 group

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compared to T0 group. The gamma glutamyl transferase (U/L) concentration of blood was comparable among the groups. Rumen degradable protein (RDP) percentages were  $26.47 \pm 0.02$ ,  $22.52 \pm 0.01$  and  $22.53 \pm 0.02$  for untreated, heat treated and formaldehyde treated soybean meal, respectively. Undegradable dietary protein (UDP) percentages were  $18.55 \pm 0.01$ ,  $22.51 \pm 0.01$  and  $22.52 \pm 0.01$  for the corresponding feeds. RDP percentages were lower ( $P < 0.01$ ) in heat treated and formaldehyde treated soybean meal than untreated soybean meal whereas UDP percentages were significantly higher ( $P < 0.01$ ) in heat treated and formaldehyde treated soybean meal compared to untreated soybean meal. The feed cost per kg of milk was lower in T1 and T2 groups (Rs.28.77 and Rs.29.60) compared to T0 (Rs.32.83) group.

It was observed that feeding of heat treated soybean meal (T1) and formaldehyde treated soybean meal (T2) showed better results in terms of milk yield, FCM yield and digestibility of nutrients like dry matter and crude protein over untreated soybean meal (T0). Hence, it can be concluded that treatment of soybean meal has a significant effect on milk yield due to enhancement of nutrient bioavailability caused by lowering of rumen degradable protein (RDP). Comparing the heat treatment and formaldehyde treatment of soybean meal, heat treatment could be recommended from practical and economic point of view as there is no risk of chemicals.

## **Understanding the Physio-Biochemical Status of Anoestrus Crossbred Cows and Comparative Evaluation of Certain Treatment Regimes**

*Chiranjeev Archarya*

The genital status, certain hormonal and blood biochemical profiles of anoestrus and normal cyclic crossbred cows and the efficacy of certain hormonal, nutritional and herbal treatment regimes fortified with bypass fat was carried out. The cows were subjected to 7 different treatment regimes viz, T1 (hormonal treatment like heat synch protocol), T2 (heat synch protocol+ By pass fat), T3 (feeding of HMTBa minerals vitamins and herbs bolus,T4 (HMTBa minerals vitamins herbs bolus+bypass fat), T5 (feeding of herbal medicine AV/OIP/22), T6 (Bypass fat fortified with AV/OIP/22) and T7 (By pass fat). The genital status, percent of estrus response, estrus intervals, conception rate and blood biochemical profiles of anoestrus crossbred cows was studied. The blood biochemical constituents, viz. oestrogen, progesterone, cortisol, IGF-I, calcium, inorganic phosphorus, zinc, total protein and cholesterol were estimated on day 0 (before treatment) and day of estrus. The study revealed that overall incidence of infertility was 14.7%. The incidence of silent oestrus and anoestrus were 4.58 and 2.69% respectively. The average ovarian follicle diameter (mm) was found to be  $9.62 \pm 0.3$  and  $8.40 \pm 0.4$  mm in normal and true anoestrus cows respectively. Highly significant difference in the mean serum levels of cortisol and cholesterol on the day of examination between normal cyclic and true anoestrus cows was seen. However, no significant difference was recorded in the serum oestrogen, progesterone, IGF I, Phosphorus and Zinc. But significant difference was seen in serum calcium and total protein levels.

The oestrus response was found to be improved in T2 and T6 groups. Further, the oestrus interval from end of treatment to onset of 1<sup>st</sup> oestrus was found to be shortest in T1 and highest in T6. The overall conception rate in different treatment groups showed no improvement in conception rate when compared with known treatment groups. The mean levels of oestrogen before and after treatment were significantly higher in all the treatment groups. Highly Significant differences in serum progesterone was seen in T1, T2, T4 and T6 group whereas group T3 and T5 showed significance

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difference. The serum IGF-I showed highly significant difference in all the groups except in T7. Serum calcium level showed highly significant difference in T1, T4, T5, T6 group whereas in T3 group it there was significant difference. On further studies, the serum profile revealed highly significant differences in phosphorus values in T6 group. The serum zinc in T5 and T6 groups were highly significant. The serum cholesterol levels in group T6 showed highly significant difference. From the results of the present study following conclusions could be drawn.

The overall incidence of anoestrus and silent oestrus was found to be 2.69% and 4.58% respectively. The mean progesterone, cholesterol and total protein was significantly higher and cortisol and calcium levels was significantly lower in true anoestrus cows compared to normal cows. The oestrous response rate (%) was found to be highest when treated with Bypass fat fortified with heat synch protocol and interval from end of treatment to onset of 1<sup>st</sup> oestrus was found to be highest in heat synch protocol. The conception rate was found to be highest 80% in animals treated with heat synch and Bypass fat fortified with heat synch.

## Differential Cytokine Gene Expression in Postpartum Endometritic Crossbred Cows

*Maradona Nath*

The present research work was conducted to find out the incidence of postpartum (PP) endometritis and to study the differential cytokine gene expression during early postpartum period and its variation following treatment in endometritic crossbred cows. The incidence of postpartum endometritis was 25.19 per cent on examination of 258 postpartum crossbred cows based on white side test and cytological examination of uterine endometrial discharge obtained by cytobrush technique adopting the threshold level of 4.00 per cent PMN. Out of 18 postpartum stalled cows that were selected on the basis of white side test, cytological, haematological examination and liver function test, six apparently healthy animals were kept as control (Group- A) and 12 animals (Group-B) without history of abnormal parturition but found to be endometritic on cytological examination of uterine sample at first PP oestrus were subjected to study cytokine gene expression. Blood samples were collected by jugular venipuncture from all the cows of group-A and B on the day of parturition i.e., Day 0, Day 7 PP, Day 14 PP, on day of first PP oestrus and on day of second PP oestrus for the study of different haematological parameters viz. Hb, TLC, DLC, TEC and PCV. Uterine biopsy samples were collected by cytobrush technique on the said days for study of cytokine gene expression of IL-10, IL-6 and IL-2. Oestrogen, Progesterone and cytokines IL-10, IL-6, IL-2 were estimated in serum samples. Uterine discharge was collected on first and second PP oestrus for bacteriological study and antibiotic sensitivity test. It was revealed that the level of TLC ( $20.18 \pm 1.85$  m/mm<sup>3</sup>), Neutrophil ( $26.32 \pm 1.68$  %) and Lymphocyte ( $68.40 \pm 2.38$  %) count were significantly ( $P < 0.01$ ) higher on first PP oestrus in postpartum endometritic cows than the healthy cows. Other haematological parameters did not vary significantly between the groups of animals on the days of observation. Oestrogen and progesterone concentrations did not differ significantly between the two groups. Significantly ( $P < 0.05$ ) higher expression of cytokine gene IL-10 (4.85 fold), IL-6 (3.95 fold) and IL-2 (2.98 fold) was observed on first PP oestrus in postpartum endometritic cows in comparison with that in non-endometritic control cows. The serum IL-10, IL-6 and IL-2 concentrations were significantly ( $P < 0.01$ ) higher in endometritic cows on first PP oestrus ( $71.47 \pm 1.60$ ,

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1210.91 ± 3.40 and 477.63 ± 3.81 pg/ml respectively) than the control cows. Uterine samples from all the endometritic cows in Group-B (12/12) i.e. 100.00 per cent were found to be positive for presence of bacteria on first PP oestrus before treatment. Two out of twelve cows i.e. 16.67 per cent exhibited bacterial presence on second PP oestrus following treatment. Two types of bacterial isolates were identified, Staphylococcus spp. and E. coli. The Staphylococcus spp. was predominant with percentage frequency of occurrence of 58.33 on first PP oestrus (pretreatment) in group-B cows. The percentage frequency of occurrence for E. coli on first PP oestrus was 41.66 in Group-B. Uterine discharge was free from E. coli infection on second PP oestrus (posttreatment). The presence of Staphylococcus spp. in uterine samples of endometritic cows after treatment with sensitive antibiotic reduced to 16.67 per cent on second PP oestrus. A total of seven (7) Staphylococcus spp. and five (5) E. coli isolates were isolated from the cultured uterine samples. Out of the total seven (7) Staphylococcus spp. isolated 5 isolates were found to be sensitive to ciprofloxacin (71.43 %). Three (3) out of total five (5) E. coli isolates were found to be sensitive to ciprofloxacin (60.00 %). The overall sensitivity of both the bacterial isolates was higher for ciprofloxacin (65.72 %) and hence intrauterine infusion of ciprofloxacin was selected for intrauterine antibiotic for treatment of endometritis in group B crossbred cows. The frequency of occurrence of bacteria decreased substantially in endometritic cows after intrauterine antibiotic infusion based on sensitivity test indicating the efficacy of the antibiotic used. The first A.I. conception rate in endometritic crossbred cows after intrauterine antibiotic treatment was 58.33 per cent which was higher than that in control cows. The present findings indicated that intrauterine treatment with most sensitive antibiotic was effective in postpartum endometritis of crossbred cows. It was concluded that upregulated cytokine gene expression and higher concentration of serum cytokines at first postpartum oestrus could serve as an indicator of endometritis which could be effectively addressed by intra-uterine antibiotic based on antibiotic sensitivity test for the enhancement of fertility in crossbred dairy cows.

## **Optimizing Cryopreservation of Semen and Artificial Insemination in Pigs**

*Manoj Kumar Kalita*

A total of forty-two ejaculates from six Lumsniang crossbred boars, maintained at Livestock Research Farm, DAFS, ICAR Research complex for NEH Region, Umiam, Meghalaya were used in the present study. Semen was collected twice weekly by gloved hand method using dummy sow in a sterilized semen collection bag fitted inside the insulated collection cup. The sperm rich fraction of 42 ejaculates showing more than 70 per cent initial motility was considered for further processing and freezing. The semen parameters were assessed in fresh ejaculates, 1 hour after equilibration and during post thawed period. The extended semen with different nanoparticles, packaging systems and thawing temperatures and times were assessed for optimizing of cryopreservation. A total of 5 semen samples, including one fresh and rest four frozen with BTSLEYG extender, out of which three with ZnO-NPs, Se-NPs, Fe<sub>3</sub>O<sub>4</sub>-NPs nanoparticles and one Control (without nanoparticles) were assessed to study the ultrastructural changes of spermatozoa by scanning electron microscope and transmission electron microscope, respectively. The optimized frozen thawed boar semen with best nanoparticles, packaging methods and thawing temperatures and times was used to assess conception rate following artificial insemination in oestrus pig.

The overall mean percentages of fresh boar semen evaluated for volume, pH, sperm concentration, total sperm per ejaculate, initial motility, live sperm, intact-acrosomal membrane (by Giemsa), intact plasma membrane integrity, sperm viability, acrosomal intact (by FITC-PSA), mitochondrial membrane potentiality (MMP) of spermatozoa and sperm DNA integrity revealed no significant difference between boars.

The boar semen after 1 hour of equilibration in BTSLEYG extender with ZnO-NPs (10 $\mu$ M), Se-NPs (1.0  $\mu$ g), Fe<sub>3</sub>O<sub>4</sub>-NPs (0.192 mg/ml) and without nanoparticles (Control) group showed non-significant ( $P < 0.05$ ) difference for sperm motility, live sperm, intact-acrosomal membrane (FITC-PSA), mitochondrial membrane potentiality and sperm DNA integrity. However, intact plasma membrane integrity and sperm viability live and moribund population showed significant difference ( $P < 0.01$ ) between different nanoparticles. The boar semen with ZnO-NPs (10  $\mu$ M) showed significantly ( $P < 0.05$ ) highest per cent of intact plasma membrane integrity than Se-NPs (1.0  $\mu$ g),

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Fe<sub>3</sub>O<sub>4</sub>-NPs (0.192 mg) and control (without nanoparticles). Similarly, for sperm viability- live exhibit no significant difference amongst ZnO-NPs (10 µM), Se-NPs (1.0 µg) and control (without nanoparticles). The sperm viability- moribund showed no significant difference amongst Se-NPs (1.0 µg), Fe<sub>3</sub>O<sub>4</sub>-NPs (0.192 mg/ml) and control (without nanoparticles) group.

Assessment of quality of frozen boar semen with different nanoparticles (NPs) irrespective of packaging system and thawing temperatures and times revealed that sperm motility, live sperm, intact acrosomal membrane and intact-PMI and sperm viability-live, Intact-acrosomal membrane (FITC-PSA), mitochondrial membrane potentiality-high and sperm DNA normal showed significantly higher ( $P < 0.05$ ) in ZnO-NPs (10µM) than Se-NPs (1.0 µg), Fe<sub>3</sub>O<sub>4</sub>-NPs (0.192 mg/ml) and Control (without nanoparticles). However, per cent of sperm viability-dead, non-intact-acrosomal membrane (FITC-PSA), mitochondrial membrane potentiality-low and sperm DNA damage showed significantly higher ( $P < 0.05$ ) in Fe<sub>3</sub>O<sub>4</sub>-NPs (0.192 mg/ml) than ZnO-NPs (10µM), Se-NPs (1.0 µg), and Control (without nanoparticles). There was no significant difference observed between Se-NPs (1.0 µg), and Control (without nanoparticles) for sperm motility, live sperm, intact acrosome membrane, Mitochondrial membrane potential-high and Intact acrosome (FITC-PSA).

Assessment of quality of frozen boar semen of different packaging systems irrespective of nanoparticle and thawing temperatures and times revealed that per cent of sperm motility, live sperm, intact acrosomal membrane and intact-PMI and sperm viability-live, intact-acrosomal membrane (FITC-PSA), mitochondrial membrane potential-high and sperm DNA integrity significantly ( $P < 0.05$ ) higher in straws than sachets and cryovials,. The ANOVA indicated significant ( $P < 0.01$ ) difference between straws, sachets and cryovials.

Assessment of quality of frozen boar semen of different thawing temperatures and times irrespective of nanoparticles and packaging systems revealed that per cent of sperm motility, live sperm, intact acrosomal membrane and intact-PMI, sperm viability-live, intact-acrosomal membrane (FITC-PSA), mitochondrial membrane potential-high showed significantly ( $P < 0.05$ ) higher in 720 C for 9 sec and 500 C for 20 sec. than 370 C for 1 min. However, per cent of non-intact acrosome (FITC-PSA), sperm DNA normal and damage showed no significant difference between semen thawed at 370 C for 1 min, 500 C for 20 sec and 720 C for 9 sec.

In Scanning electron microscope the fresh ejaculates spermatozoa were having normal structure of head, middle piece, principal piece and terminal piece with intact plasma membrane. However, after thawing with different nanoparticles in 0.5 ml straw at 500 C for 20 sec, majority of the spermatozoa showed detached head, rupture plasma membrane, bent tail, stump tail, coiled tail and middle piece defects. The maximum and worst damage was recorded with the semen extended with Fe<sub>3</sub>O<sub>4</sub>-NPs (0.192 mg/ml) followed by Se-NPs (1.0µg), and Control and least ultrastructure changes was found in ZnO-NPs (10µM).

In Transmission electron microscope the fresh spermatozoa were having intact plasma membrane over head and middle piece, Acrosome and acrosomal apical ridge were normal and intact, nucleus was electron opaque. However after thawing with different nanoparticles in 0.5 ml straw at 500 C for 20 sec, majority of the spermatozoa showed swollen, separating and rupture plasma membrane over the head region. Fusion of plasma membrane with outer acrosomal membrane and formation of large spaces between plasma membrane and outer acrosomal membrane were commonly seen. Most of the cells showed ruptured of plasma membrane over the middle piece and thinned mitochondrial matrix was also seen after thawing. The extreme and worst damage was recorded with the semen extended with Fe<sub>3</sub>O<sub>4</sub>-NPs (0.192 mg/ml) followed by Se-NPs (1.0µg), and Control and least ultrastructure damage was observed in ZnO-NPs (10µM).

A total of 37 numbers of sows were inseminated with optimized frozen boar semen with ZnO-NPs (10µM), packaged in straws (0.5ml) and thawed at 500 C for 20 seconds obtained 40.00 per cent non-return rate, while 29.41 per cent obtained in control. Sows were inseminated twice at 30 and 42 hours following onset of oestrus @ 4-5 x 10<sup>9</sup> sperm in 5 ml thawed semen diluted with 60 ml of BTS.

## **Characterization of Membrane Proteins in Fresh and Frozen Spermatozoa in Assam Hill Goat**

*Mitali Dutta*

Thirty six pooled ejaculates from nine Assam Hill Goat bucks aged 2 to 2.5 years collected by artificial vagina method were used to study the fresh and frozen semen characteristics, characterization of seminal plasma proteins, characterization of sperm membrane proteins in fresh and frozen semen and to study the effect of supplementation of three membrane stabilizers, each at two different concentrations *viz.* 50 and 80 mM sucrose, 50 and 100 mM trehalose, and 100 and 150ng/ml IGF-1 to tris-citric acid fructose egg yolk glycerol extender (TCFEYG) on post-thaw semen characteristics and on sperm membrane proteins of frozen semen. Characterization of two fertility related membrane proteins *viz.* ADAM1 and ADAM2 were also done in fresh and frozen spermatozoa of Assam Hill goat by western blotting and immunolocalization using anti ADAM1 and anti ADAM2 antibodies raised in rabbit respectively. The mean per cent progressive sperm motility, HOST-reacted sperm and intact acrosome was significantly ( $p<0.01$ ) higher in fresh semen than in semen frozen in different extenders. The mean per cent post-thaw progressive motility, HOST-reacted sperm and intact acrosome differed significantly ( $p<0.01$ ) between the different extenders. However, no significant difference was observed in the mean per cent HOST-reacted sperm between TCFEYG supplemented with 100mM trehalose and TCFEYG supplemented with 100ng/ml IGF-1 and no significant difference was observed in the mean per cent intact acrosome between TCFEYG supplemented with 100mM trehalose and TCFEYG supplemented with 100ng/ml IGF-1 and between TCFEYG supplemented with 50mM sucrose and TCFEYG supplemented with 50mM trehalose. The mean per cent post-thaw progressive sperm motility, HOST-reacted sperm and intact acrosome in frozen semen was found to be the highest in TCFEYG supplemented with 150ng/ml IGF-1.

SDS- PAGE of seminal plasma and sperm membrane extract of fresh semen revealed the presence of 20 and 24 protein bands respectively with molecular weights ranging from 10 kDa to 240 kDa. The SDS-PAGE electrophoretogram of sperm membrane proteins of semen frozen using TCFEYG and TCFEYG supplemented with 50mM sucrose (TCFEYG + 50mM S) and, 80mM sucrose (TCFEYG + 80mM S)

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revealed 21 protein bands with molecular weights ranging from 10 kDa to 240 kDa. The 21 protein bands were same with that observed in the sperm membrane of fresh spermatozoa, except three protein bands. These three proteins of molecular weights 23 kDa (~Phosphatidyl-ethanolamine-binding protein), 29 kDa (~Proacrosin binding protein) and 42 kDa (~tyrosine- phosphorylated SPACA1) were absent in TCFEYG and TCFEYG supplemented with 50mM, and 80mM sucrose. The SDS-PAGE electrophoretogram of sperm membrane proteins of semen frozen using TCFEYG supplemented with 50mM trehalose (TCFEYG + 50mM T), and 100mM trehalose (TCFEYG + 100mM T) revealed 22 protein bands with molecular weights ranging from 10 kDa to 240 kDa. The 22 protein bands were same with that observed in the sperm membrane of fresh spermatozoa, except two protein bands. These two proteins of molecular weights 29 kDa (~Proacrosin binding protein) and 42 kDa (~tyrosine-phosphorylated SPACA1) were absent in TCFEYG supplemented with 50mM, and 100mM trehalose. The supplementation of trehalose to the basic TCFEYG extender at 50mM and 100mM concentrations, however, had a protective effect on the sperm membrane protein of 23kDa when compared to the basic TCFEYG extender and TCFEYG supplemented with 50 and 80mM sucrose. The SDS-PAGE electrophoretogram of sperm membrane proteins of semen frozen using TCFEYG supplemented with 100ng/ml IGF-1 (TCFEYG + 100ng/ml IGF-1), and 150ng/ml IGF-1 (TCFEYG + 150ng/ml IGF-1) revealed 21 protein bands with molecular weights ranging from 10 kDa to 240 kDa. The 21 protein bands were same with that observed in the sperm membrane of fresh spermatozoa, except three protein bands. These three proteins of molecular weights 29 kDa (~Proacrosin binding protein), 130 kDa (~lipoprotein binding protein) and 240 kDa (~golgi-associated retrograde protein) were absent in TCFEYG supplemented with 100ng/ml, and 150ng/ml IGF-1. Supplementation of the basic tris extender with IGF1 at concentrations of 100ng/ml and 150ng/ml resulted in protection of sperm membrane proteins of molecular weights 23kDa (~Phosphatidyl-ethanolamine-binding protein) and 42 kDa (~tyrosine-phosphorylated SPACA1) during the freeze-thaw process when compared to the basic tris extender and tris extender supplemented with sucrose. The 23 kDa protein was however, also found to be protected in the tris extender supplemented with trehalose.

ADAM1 was detected as three bands of ~ 25kDa, 66kDa and ~ 90kDa in the sperm membrane extract of fresh sperm. However, in the sperm membrane extract of semen frozen using TCFEYG, TCFEYG + 80mM S, TCFEYG + 50mM S, TCFEYG + 50mM T, TCFEYG + 100mM T, TCFEYG + 100ng/ml IGF-1 and TCFEYG + 150ng/ml IGF-1 extenders it was detected as ~25kDa, 66kDa and ~90kDa; ~25kDa, 66kDa and ~90kDa; ~25kDa, ~49kDa,~66kDa, ~90kDa and ~110kDa; ~25kDa,66kDa and ~90kDa; ~25kDa, 66kDa and ~90kDa; ~25kDa, ~49kDa,~66kDa, ~90kDa and ~110kDa ; and ~25kDa, ~49kDa,~66kDa, ~90kDa and ~110kDa respectively. In the present study, freeze-thaw process and supplementation of tris extender used for freezing of semen with membrane stabilizers such as sucrose, trehalose and IGF-1 has been found to result in certain variations in the molecular weight of ADAM1. However,

reactive protein bands of 25kDa, 66kDa and 90kDa were found to be consistently present in the fresh sperm as well as sperm frozen in different extenders. ADAM2 was detected as two bands of ~ 80kDa and ~ 130kDa in the sperm membrane extract of fresh sperm. However, in the sperm membrane extract of sperm frozen using TCFEYG, TCFEYG + 80mM S, TCFEYG + 50mM S, TCFEYG + 50mM T, TCFEYG + 100mM T, TCFEYG + 100ng/ml IGF-1 and TCFEYG + 150ng/ml IGF-1 extenders it was detected as ~70kDa, ~80kDa, ~100kDa and ~130kDa; ~70kDa, 80 kDa and ~130kDa; ~70kDa, ~80kDa, ~90kDa, ~100kDa and ~130kDa; ~70kDa, ~80kDa, and ~100kDa; ~70kDa, ~80kDa, and ~100kDa; ~70kDa, ~80kDa, and ~100kDa; and ~70kDa, ~80kDa, and ~100kDa respectively. In the present study, freeze-thaw process and supplementation of tris extender used for freezing of semen with membrane stabilizers such as sucrose, trehalose and IGF1 has been found to result in certain variations in the molecular weight of ADAM2. However, a protein band of 80 kDa was found to be consistently present in the fresh sperm as well as sperm frozen in different extenders. Immunolocalization of the ADAM1 and ADAM2 proteins revealed the presence of the proteins in the acrosomal region of sperm cells in both fresh and frozen semen. Present study revealed no change in the localization of ADAM1 and ADAM2 post freezing thereby indicating that there is no effect of freezing on the distribution of these two proteins.

It was concluded that cryopreservation of Assam Hill Goat semen resulted in alterations in sperm membrane proteins, however, supplementation of membrane stabilizers exerted protective effects. Based on post-thaw semen characteristics and study on membrane proteins it was found that IGF-1 @ 150ng/ml was superior to other membrane stabilizers in maintaining post-thaw semen quality.

## **Effect of Cryopreservation on Semen Biochemical Parameters Including Lipid Profile in Beetal and Assam Hill Goat**

*Prasanta Kumar Das*

A total of 72 ejaculates comprising six ejaculates from each of 12 bucks (six Beetal and six Assam Hill Goat) were used to study the effect of cryopreservation on the physical and biochemical characteristics of semen including sperm ultrastructure. The physical characteristics of fresh semen *viz.*, ejaculate volume, mass activity, initial sperm motility, live sperm, sperm concentration, cold shock resistance index, acrosomal integrity, HOST-reacted sperm and sperm abnormalities were studied by conventional methods. The biochemical characteristics *viz.*, sodium, potassium, calcium, total cholesterol, total lipid, AST, ALT and lipid profile were studied in seminal plasma, and total cholesterol, total lipid and lipid profile were also studied in spermatozoa of fresh and frozen semen. Semen was extended in Optixcell extender and frozen in 0.25 ml straws using liquid nitrogen vapour and stored in liquid nitrogen. Each sample was evaluated on the following day for sperm motility, live sperm, acrosomal integrity and HOST-reacted sperm. The biochemical characteristics studied after freezing in extracellular medium were the same as in case of seminal plasma. Sperm ultrastructure was studied both in fresh and frozen-thawed spermatozoa.

Physical and biochemical characteristics of semen of Beetal and Assam Hill Goats were within normal range and differed significantly between breed for ejaculate volume ( $P<0.001$ ), sperm concentration ( $P<0.001$ ), cold shock resistance ( $P<0.05$ ), Host-reacted sperm ( $P<0.01$ ), sodium ( $P<0.001$ ), potassium ( $P<0.001$ ) and total lipid ( $P<0.001$ ). Post-thaw sperm parameters *viz.* sperm motility, live sperm, acrosomal integrity and HOST-reacted sperm, and content of biochemical constituents *viz.* sodium, potassium, calcium, total cholesterol and total lipid decreased after freezing in semen of both the breeds, while AST and ALT increased. Thirteen and fourteen fatty acids were identified in the seminal plasma of Beetal and Assam Hill Goat bucks, respectively. Pentanedioic acid was identified only in seminal plasma of Assam Hill Goat. In the extracellular medium of frozen Beetal semen, all the fatty acids of seminal plasma of fresh semen were present, however, in Assam Hill Goat bucks both Dodecadienoic acid

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and Pentanedioic acid which were present in seminal plasma of fresh semen were found to be absent in frozen semen. Breed variation was observed in respect of Pentanedioic acid of fresh semen. Freezing had significant effect in alteration of membrane stabilizing fatty acids *viz.* Erucic acid, carboceric acid, linoleic acid, tricontanoic acid, arachidic acid, eicosadienoic acid, margaric acid, mentanic acid, tetradecadienoate, tridecanoic acid, heneicosylic acid, cerotic acid and tricosanoic acid. Major ultrastructural changes in spermatozoa after freezing were separating and ruptured plasma membrane, fusion of plasma membrane with outer acrosomal membrane, swelling of acrosome and loss of acrosomal content.

Based on the physical and biochemical parameters studied it could be concluded that cryopreservation of goat semen has deleterious effects on fatty acid profile of seminal plasma and sperm plasma membrane, and also on sperm ultrastructure in both Beetal and Assam Hill Goat. The proportion of loss of plasma membrane fatty acids after freezing was lower in Assam Hill Goat as compared to that of Beetal goat. Post-thaw semen quality in Assam Hill Goat was superior to that of Beetal goat.

## **Effect of Antioxidants on Quality and Relative Expression of Fertility Related Genes of Cryopreserved Beetal Buck Semen**

*W. Lomen Singh*

A total of 120 ejaculates from six Beetal bucks, collected by artificial vagina were used in the study. Immediately after collection each ejaculate was evaluated for volume, mass activity and initial sperm motility and the ejaculates having volume 0.8 ml or more, mass activity (0 to 4+ scale) 3+ or more and initial sperm motility 70 per cent or more were pooled. A total of 48 pooled ejaculates comprising 12 pooled ejaculates for each experiment were evaluated for sperm motility, live sperm, intact acrosome, sperm concentration, HOST-reacted sperm and sperm abnormalities. Each pooled ejaculate was split into two parts and one part was used for assessment of glutathione-S-transferase (GST), superoxide dismutase (SOD), catalase (CAT), glutathione reductase (GR), glutathione peroxidase (GPx), alanine aminotransferase (ALT), aspartate aminotransferase (AST), lactate dehydrogenase (LDH), and malondialdehyde (MDA) level in the seminal plasma. The other part of pooled semen was split into four parts, then centrifuged and the seminal plasma was discarded. The centrifugate of the first three parts was extended separately in Tris extender containing vitamin E @ 1, 2 and 3 mM in experiment I; IGF-1 @ 100, 125 and 150 ng/ml in experiment II; crocin @ 1, 2 and 3 mM in experiment III; and vitamin E @ 2 mM (best of expt. I), IGF-1 @ 125 ng/ml (best of expt. II) or crocin @ 1 mM (best of expt. III) in experiment IV while the fourth part was kept as control in each experiment. Semen was frozen in 0.25 ml French straws using static horizontal vapour freezing. Frozen semen was thawed in warm water at 37°C for 30 seconds for evaluation. Each semen sample was evaluated after freezing in experiment I, II and III for sperm motility, intact acrosome (Giemsa stain), HOST-reacted sperm and intact DNA (AO stain) and in experiment IV for sperm motility, intact acrosome (FITC-PSA stain), HOST-reacted sperm, viability (CFDA + PI stain), high mitochondrial potential (JC-1 stain) and intact DNA. Semen after freezing in all the experiments was evaluated for GST, SOD, CAT, GR, GPx, ALT, AST, LDH and MDA levels in the extracellular fluid by standard methods. In experiment IV, the relative

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expression of certain fertility related genes and their correlation with seminal attributes in frozen-thawed Beetal buck spermatozoa as well as fertility rate of frozen semen was also studied.

In Beetal bucks all the seminal attributes studied immediately after collection and pooling were within normal ranges. Semen samples extended with Tris extender containing vitamin E @ 1, 2 and 3 mM or no additive (control) and with Tris extender containing IGF-1 @ 100, 125 and 150 ng/ml or no additive differed significantly ( $P < 0.001$ ) in respect of sperm motility, intact acrosome, HOST-reacted sperm, intact DNA, GST, SOD, CAT, GR, GPx, ALT, AST, LDH and MDA after freezing. Semen samples extended with Tris extender containing crocin @ 1, 2 and 3 mM or no additive differed significantly ( $P < 0.05$ ) in respect of sperm motility and intact acrosome after freezing. While HOST-reacted sperm, intact DNA, GST, SOD, CAT, GR, GPx, ALT, AST, LDH and MDA differed significantly ( $P < 0.001$ ) after freezing in Tris extender containing crocin @ 1, 2 and 3 mM or no additive. In semen extended using Tris extender containing best concentration of vitamin E (2 mM), IGF-1 (125 ng/ml) and crocin (1 mM) or no additive differed significantly ( $P < 0.001$ ) in respect of sperm motility, intact acrosome, HOST-reacted sperm, viability, MMP+, intact DNA, GST, SOD, CAT, GR, GPx, ALT, AST, LDH and MDA after freezing.

*NFE2L2*, *GPx4*, *CAT* and *SOD2* gene expression was significantly ( $P < 0.05$ ) higher in IGF-1 group compared to that in vitamin E and crocin groups, however, no significant ( $P > 0.05$ ) differences were recorded between vitamin E and crocin groups.

Correlation study revealed that sperm motility showed a significant ( $P < 0.05$ ) positive correlation with all the four target genes, irrespective of the antioxidant treatment. The target genes also showed a positive correlation with all the seminal attributes in different antioxidant groups. Although the kidding rate (doe kidded per inseminated doe) did not differ significantly ( $P > 0.05$ ) between groups, the values were found to be the highest in the IGF-1 @ 125 ng/ml group.

Based on the semen parameters studied it was concluded that IGF-1 @ 125 ng/ml, was found to be superior to other additives studied in maintaining post-thaw semen quality.

# **Histological, Ultrastructural and Molecular Studies on Guard Hair For Species Difference of Hoolock Gibbons (Hoolockhoolock) Found in Assam, Arunachal Pradesh and Meghalaya**

*Jahan Ahmed*

Hoolock gibbons are the only ape species found in India and its population is confined to the north eastern states of India. The Hoolock gibbons are tailless and have distinctive call pattern. The gibbons have strong hook shaped hands for grasping branches, brachiating arms and long and strong legs to help them in jumping and propelling across branches of trees. Gibbons found in India has been identified based on their phenotypic characters as Western Hoolock gibbons found in Assam, Meghalaya, Nagaland, Tripura and Mizoram while the ones found in Arunachal Pradesh were classified as Eastern hoolock gibbon. These classification is purely based on the external observation and phenotypic characters. There has been a debate regarding the species found in India, initially it was believed to be one single species but later on it was found that there are two species namely the Western Hoolock gibbon and Eastern Hoolock gibbon. Recently, a new sub species has been added from Mishmi hills in Arunachal Pradesh called as Mishmi gibbons (*Hoolockhoolockmishmiensis*). All the classifications are based on morphological characteristics.

In Western Hoolock gibbons, the newborns are milky white and turn to black in both sexes by the age of 2 years. Males remain black and the scrotum appears distinct by seven months. In females when they reach adult stage, the hairs turn into golden blond colour with white brows and a white frame in the face. The white brows are found in males as well. These are distinctive characteristics of Western Hoolock gibbons. Eastern Hoolock gibbons are similar to the Western Hoolock gibbons except that the adult female is pale colour with more distinct paler arms. The male has a white genital tufts and spaced out white eyebrows.

The length of the hairs varied in different body regions being shortest hairs in the forehead region of male hoolock gibbons from Assam and longest in the shoulder region in both sexes of gibbons from Arunachal Pradesh, Assam and Meghalaya. The

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hairs were curly and twisted. The hairs were observed to have a fine lustrous texture. In male eastern hoolock gibbon it was observed that the hair diameter in the forehead region was  $43.43 \pm 0.19 \mu\text{m}$  and in female it was  $46.55 \pm 0.21 \mu\text{m}$ . In western hoolock gibbon from Assam the hair shaft diameter was  $43.22 \pm 0.59 \mu\text{m}$  in male and in female it was recorded as  $44.55 \pm 0.23 \mu\text{m}$ . In western hoolock gibbon from Meghalaya it was observed that the hair shaft diameter in male was  $41.88 \pm 0.26 \mu\text{m}$  while in female it was  $39.74 \pm 0.61 \mu\text{m}$ . Hair medulla was present only in the male gibbons from Arunachal Pradesh. The medulla pattern was continuous and elongated in shape. Hair medulla was observed in gibbons of all the three states. The hair medulla was elliptical and fragmented in structure. The cortico medullary index was maximum in female hoolock gibbons from Arunachal Pradesh i.e.  $34.66 \pm 0.04 \mu\text{m}$  and minimum was recorded from hoolock gibbons in Meghalaya gibbons i.e.  $30.06 \pm 0.2 \mu\text{m}$ . 2D electrophoresis revealed two protein bands in the range of 61.98 KDal and 44.3 KDal. Highest value was recorded from male Eastern hoolock gibbon at  $172.7 \pm 0.28 \text{Kdal}$  while lowest was recorded from Western hoolock gibbon from Assam at  $5.04 \pm 0.14$ . Molecular analysis indicates that hoolock gibbon from NE are Hoolockhoolock or western hoolock gibbon.

# **Comparative Cytomorphological, Cytochemical, Cytoenzymic and Ultrastructural Studies on the Blood Cells of Adult Rhode Island Red, Aseel and Non Descript Indigenous Chicken of Mizoram**

*Probal Jyoti Doley*

Matured erythrocytes were elliptical in shape and their mean length was measured to be  $12.65 \pm 0.12 \mu$ ,  $12.62 \pm 0.19 \mu$  and  $12.52 \pm 0.10 \mu$  and their mean width was measured to be  $6.83 \pm 0.09 \mu$ ,  $6.81 \pm 0.11 \mu$  and  $6.07 \pm 0.07 \mu$  in Rhode Island Red, Aseel and Zoar respectively. The heterophils were the largest granulocyte and had a mean diameter of  $10.01 \pm 0.16 \mu$ ,  $10.23 \pm 0.12 \mu$  and  $9.98 \pm 0.23 \mu$  while the basophils were the smallest granulocyte and had a mean diameter of  $8.41 \pm 0.17 \mu$ ,  $8.37 \pm 0.14 \mu$  and  $8.24 \pm 0.18 \mu$  in Rhode Island Red, Assel and Zoar respectively. The eosinophils were almost equal to the heterophils and measured  $9.53 \pm 0.10 \mu$  in Rhode Island Red,  $9.61 \pm 0.10 \mu$  in Aseel and  $9.82 \pm 0.24 \mu$  Zoar. The monocytes were the largest leukocyte and had a mean diameter of  $11.35 \pm 0.15 \mu$  in Rhode Island Red,  $11.97 \pm 0.27 \mu$  in Assel and  $11.43 \pm 0.10 \mu$  in Zoar. The lymphocytes were of variable sizes and their mean diameter ranged from  $5.96 \pm 0.13 \mu$ ,  $6.09 \pm 0.11 \mu$  and  $5.67 \pm 0.13 \mu$  to  $9.35 \pm 0.48 \mu$ ,  $9.88 \pm 0.20 \mu$  and  $9.13 \pm 0.04 \mu$  in Rhode Island Red, Assel and Zoar respectively. The thrombocytes were the smallest blood cell and had a mean diameter of  $4.85 \pm 0.10 \mu$ ,  $4.93 \pm 0.15 \mu$  and  $4.47 \pm 0.08 \mu$  in Rhode Island Red, Aseel and Zoar respectively. Reticulocytes and siderocytes were rare in the blood of Rhode Island Red, Aseel and Zoar. The heterophils of Rhode Island Red, Aseel and Zoar were positive for SBB, PAS, acid phosphatase, alkaline phosphatase and arylsulphatase while the eosinophils were positive for SBB, PAS, alkaline phosphatase, cytochrome oxidase and peroxidase. The basophils of Rhode Island Red, Aseel and Zoar were positive for toluidine blue while the thrombocytes were positive for PAS. Under Scanning Electron Microscopy the erythrocytes appeared elliptical in shape while the leukocytes and thrombocytes appeared round in shape with variable surface modifications. Under Transmission Electron Microscopy the granules of the heterophils of Rhode Island Red, Aseel and Zoar appeared predominantly fusiform in shape, the granules of the eosinophils

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appeared round in shape and that of the basophils appeared pleomorphic in shape. The cytoplasm of the monocytes, medium to large lymphocytes and thrombocytes of Rhode Island Red, Aseel and Zoar under Transmission Electron Microscopy appeared to be vacuolated and granular while that of the small lymphocytes appeared to be non vacuolated and granular.

# **Toxicological Analysis of Nanoparticles and Microparticles Used as Oral Vaccine Delivery Systems for Poultry**

*Dipankar Hazarika*

Nanoparticles and microparticles offer great applications in the field of biological sciences in terms of oral drug and vaccine delivery systems. The present study was carried out to evaluate *in-vitro* and *in-vivo* toxicity associated with chitosan nanoparticles, Gantrez® nanoparticles and poly-lactide co-glycolide (PLG) microparticle in Vero cell line and poultry bird model. The Gantrez® nanoparticles, PLG microparticles and chitosan nanoparticles were administered orally to the week old poultry birds at the limit dose of 2 g per kg body weight for assessment of oral acute toxicity and were found to be safe as the birds did not show any mortality in 24 hours post administration and the birds did not show any clinical signs till 14 days post administration. For assessment of subacute toxicity, the chitosan nanoparticles, PLG microparticles and Gantrez® nanoparticles were administered at the dose rate used in vaccine delivery that is 3 mg/kg, 15 mg/kg and 1.5 mg/kg respectively and in the dose rate 10 times of the former. The second dose was administered after 14 days. No significant elevation of serum AST, ALT, ALP, BUN and creatinine were observed in the treated groups. In addition, the significant influence of the chitosan nanoparticles, PLG microparticles, and Gantrez® nanoparticles on elevation of blood SOD, GPx and catalase were not observed. The significant upregulation of HSP70 gene expression was observed in the spleen of the group treated with PLG microparticle at the dose rate of 150 mg/kg and in the liver of the group treated with Gantrez® nanoparticle at the dose rate of 15 mg/kg. On histopathological investigation, mild changes of congestion and haemorrhage was observed in kidney of the group treated with PLG microparticles at the dose rate of 150 mg/kg body wt. while in case of liver focal aggregation of mononuclear cell was observed in Gantrez® nanoparticles at the dose rate of 15 mg/kg body weight treated group. The congested capillaries in spleen were observed in the group treated PLG microparticles at the dose rate of 150 mg/kg body weight. The groups treated with vaccine dose of chitosan nanoparticles, Gantrez® nanoparticles and PLG microparticles have shown normal cellular architecture.

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In *in vitro* study in Vero cell line, the concentration of chitosan nanoparticles and Gantrez® nanoparticles up to 1000 µg/ml did not have any influence in cellular metabolic activities and viability. However, a reduction in the cellular viability and metabolic activities were observed when PLG microparticles were used at 1000 µg/ml. At lower concentrations, all the nanoparticles/microparticles were found to be safe in terms of cytotoxicity.

# **Development of Mucosal Vaccine against *Riemerella anatipestifer* Based on Membrane Antigen Conjugated with Nanoparticle**

*Naba Jyoti Deka*

Duck plays a significant role to mitigate the poverty by upgrading the socio-economic condition of farmers. *Riemerella anatipestifer* infection is a contagious bacterial disease of ducks and causes a significant economic loss to duck rearers. The present study was carried out to develop a mucosal vaccine against *Riemerella anatipestifer* based on membrane antigen which was conjugated calcium phosphate nanoparticle. The outer membrane vesicle (OMVs) was extracted and conjugated with calcium phosphate nanoparticle. The average OMVs yield in terms of protein concentration was found to be  $122.33 \pm 3.48$  mg per litre of BHI broth. In SDS-PAGE analysis, isolated OMVs exhibited presence of 16 distinct protein bands with molecular weight ranging from 142.1 to 12.1 kDa in SDS-PAGE. Among them, seven protein bands of 74.1, 69.3, 55.5, 50.6, 45.6, 25.1 and 13.1 kDa were found relatively more distinct. The major bands detected in our findings were 42 kDa, 37 kDa and 16 kDa that corresponds to OmpA, OmpH, P6 respectively. The mean size ( $\pm$  SD) of nanoparticle was found to be  $246.20 \pm 0.53$  nm and the mean zeta potential ( $\pm$  SD) was found to be  $-25.60 \pm 5.97$ . The mean size of the nanoparticles was found to be  $129.80 \pm 11.10$  nm in size and spherical morphologies in transmission electron microscopy analysis. The optimum conditions for conjugation of OMV and calcium phosphate nanoparticles were found to be pH=6.00, amount of OMV=1.5 mg, conjugation temperature=10°C and period of conjugation=1 hour. The PD50 or the median protective dose of CAP-OMV nanoparticle was found to be 1881.10  $\mu$ g of protein. For the bacterin vaccine, the concentration of the vaccine dose was taken as  $2 \times 10^9$  cfu/ml. The immunization trial was carried out in ducks. Group I birds received 3762  $\mu$ g of protein (entrapped protein in CAP-OMV nanoparticle) preparation *via* intra nasal route and it showed the highest serum IgG and secretory IgA level than the other immunized group. Group V which was administered 0.5 ml of inactivated bacterin vaccine by subcutaneous (s/c) route elicited strong immune response after Group I. All the experimental birds were challenged with  $10 \times$  LD50 ( $\sim 2.1 \times 10^{10}$  CFU per bird) on 35 days of post primary immunization. Group

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I and group V showed 100 % survivability, while other vaccine groups showed 0 % survivability. From the present study it can be concluded that CAP-OMV nanoparticle can act as suitable mucosal vaccine delivery system for *Riemerella anatipestifer*.

## **Biochemical Profile and Innate Immune Response of Indigenous Ducks to Duck Plague Virus Infection**

*Prasanta Chabukdhara*

The present study was carried out to explore the innate immune response of indigenous ducks of Assam namely, Pati, Nageswari and Cinahanh to duck plague virus (DPV) infection reared in different agro-climatic zones of Assam *viz.* North Bank plains, Upper Brahmaputra, Lower Brahmaputra and Barrak Valley zones. A total of 397 ducks of indigenous breed/varieties were screened for the detection of DPV in the suspected ducks by PCR amplification of DPV specific DNA polymerase (UL 30) gene (446 bp). Positivity and mortality rate were recorded to be 45.84% and 50.55%, respectively.

Three experimental groups of ducks were formed *viz.* healthy, duck plague infected and recovered. The ducks under respective groups were analyzed for different hematological and serum biochemical parameters including inflammatory indices (acute phase proteins- Positive APP C-reactive protein and Negative APP Albumin) and liver specific biomarkers (GGT, ALT, AST, ALP, Total bilirubin, Direct bilirubin and Indirect bilirubin). Serum cytokines *viz.* IL-1, TNF- $\alpha$ , IL-4 and IL-10 were assessed in the birds under study. Innate immune response in different group of indigenous ducks was evaluated by studying mRNA expression profiles of certain innate immune genes (TLR 2, TLR 3, TLR 21 and RIG-I) in different tissues of birds *viz.* liver, spleen, intestine, brain and Peripheral Blood Mononuclear Cells (PBMC).

The infected birds revealed to have significantly decreased ( $P \leq 0.05$ ) PCV%, Hb, TEC, MCV, MCHC, TLC, Heterophil, Lymphocyte and Monocyte. MCV and MCH were significantly increased ( $P \leq 0.05$ ) in infected ducks. Infected birds had significantly increased ( $P \leq 0.05$ ) mean values of Glucose, Globulin and Creatinine in contrast to healthy and recovered ducks. However, significant higher values ( $P \leq 0.05$ ) of total protein, creatinine and insignificant higher values of uric acid were recorded in the diseased birds. Eosinophil, basophil, uric acid and BUN did not reveal any significant alteration in the studied birds. Serum C reactive protein (positive APP) was significantly increased while serum albumin (negative APP) decreased significantly in the infected ducks. The liver specific biomarkers ALT, AST, ALP, total bilirubin, direct bilirubin

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and indirect bilirubin were significantly increased in the infected ducks.

The serum cytokines IL- 1, TNF-  $\alpha$  and IL- 4 were significantly increased in infected ducks as compared to healthy and recovered birds. Pati ducks in the healthy and recovered groups had significant higher values ( $P \leq 0.05$ ) of IL- 1. RT- qPCR analysis revealed significant upregulated expression of studied innate immune genes (TLR 2, TLR 3, TLR 21 and RIG-I) in different tissues *viz.* liver, spleen, intestine, brain and PBMC of infected ducks and the same genes were seen to remain upregulated post recovery.

Attempts can be made in future to further explore targeted immunomodulation in ducks which will help to enhance the resistance potential of ducks to duck plague virus infection. Documentation of different hemato-biochemical and innate immune genes expression profile will help in future to undertake a suitable breeding strategy to develop disease resistant varieties of ducks against duck plague virus infection.

# **Development of a Chitosan Based Packaging Film Incorporated with Zinc Oxide Nanoparticles and Green Tea Extract: Its Effect on Shelf Life of Meat and Meat Product (Chicken)**

*Santosh Upadhyay*

The present work was aimed at developing an active biopolymeric packaging film based on chitosan with antioxidant and antimicrobial activity and to assess its effect on shelf life of meat and meat product. Zinc oxide nanoparticle (ZnO NP) at a concentration of 2%w/w of chitosan and green tea extract (GTE) at 0.2% w/w of chitosan film was used after determining the antimicrobial activity of ZnO nanoparticles using agar well diffusion assay and antioxidant activity of GTE using DPPH inhibition assay. Four different combinations of films were prepared- F1 (Chitosan alone), F2 (Chitosan+ZnONPs), F3 (Chitosan+GTE) and F4 (Chitosan+ZnONPs+GTE) and compared with commonly used LDPE (control) packaging film for their physicochemical, mechanical, antioxidant and antimicrobial activities. The SEM of the films at resolution of 5000x revealed uniformity of the film in all four different types of combinations confirming the proper dissolution of the added zinc oxide nanoparticles and green tea extract in the film. All the four combinations of films were transparent and of desired thickness. The films F2 and F4 were found to have tensile strength but low elongation at break % as compared to LDPE. The films F2 and F4 showed potent antimicrobial property as compared to other films while F3 and F4 showed potent antioxidant activity. The film F4 possesses both strong antioxidant and antimicrobial activity with good tensile strength and was found to be the best among all the four film combinations. The developed films were then used for wrapping of fresh meat and meat loaf (chicken) and to assess their effect on shelf life at both ambient and refrigeration temperature. Samples without film were used as negative control. The fresh meat wrapped with F4 could maintaining the quality attributes in terms of physicochemical properties like TBARS, pH, colour and microbiological qualities like standard plate count and coliform count below the threshold level up to 12 hours at ambient temperature and up to 9 days of storage at refrigeration temperature. The meat loaf wrapped with F4 could be kept up to 15 hours of storage at ambient temperature and up

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to 15 days of storage at refrigeration temperature maintaining the quality attributes in terms of pH, TBARS, SPC, colour and textural properties. Sensory panel evaluation also suggested that the meat loaf wrapped with F4 remained acceptable up to 15 days at refrigeration temperature with good sensory scores. A significant difference ( $p < .01$ ) in crude protein and ether extract contents were observed in the fresh meat and meat loaf without film and those wrapped with F1, F2 and F3. However, minimum decline was observed in samples wrapped with F4. Migration studies on zinc oxide nanoparticles revealed no significant migration of zinc oxide nanoparticles from the film to the food matrix.

## **Epidemiology of Rabies in Assam**

*Prasanta Kumar Boro*

In an epidemiological study on rabies in 11 districts in Assam, 65 post-mortem brain samples belonging to nine species were collected by foramen magnum approach from clinically suspected domestic and wild animals and tested at the WOAHP Reference Laboratory for Rabies, Hebbal, Bengaluru – 560 024, Karnataka. Simultaneously, a questionnaire survey on the community was undertaken to evaluate the epidemiological determinants on rabies transmission. Forty two (64.61 %) samples tested positive by LFA and DFA. Of the nine species, five species i.e. cattle 27 (41.53%), dog 9 (13.85%), goat 4 (6.15%), pig 1(1.53%) and pony 1(1.53%) were confirmed for rabies. Aggression in 41 (97.62%) cases was the most common signs exhibited by the affected animals before death with only one positive case (2.38%) showing paralytic signs. There was no dog bite history in 33 (78.57%) cases while 9 (21.43%) cases had. Most of the livestock were free ranging and grazed nearby protected areas where presences of wild carnivores were evident. Seasonal distribution revealed similar numbers of cases (45.24%) during rainy and flood season (July-September) and post-harvesting (December-February) winter season. Gender-wise, 20 (47.62%) positive cases of cattle and goats were either pregnant or recently calved. Prevalence of rabies was found to be highest (64.29%) in the animals more than 3 years of age, followed by the animals between 1 to 3 years (23.81%) and below one year of age (11.90%). In rural areas distribution of rabies was highest (52.31%), semi-urban (9.32%) and urban (3.08%). Distribution maps of rabies in different parts of Assam were generated based on the GPS locations of the positive cases and heat map revealed a high risk zone in the Golaghat district. The areas adjoining the tea gardens had higher rabies cases (23, 54.76%). The questionnaire survey revealed a very low level of community awareness regarding rabies and its transmission. Lack of proper information from the field staff, immediate collection of samples from field and transportation of samples to the laboratory maintaining cold chain were the major constraints found during the study.

**Key words:** Rabies, livestock, LFA, DFA, GIS, distribution map, questionnaire, Assam

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**Major Adviser: Dr. (Mrs.) Jyoti B. Dutta**



# **Phenotypic and Genotypic Characterization of Methicillin Sensitive and Resistant *Staphylococcus aureus* (Mssa & Mrsa) Isolated from Bovine Mastitis**

*Arfan Ali*

The present study was undertaken on characterization of *Staphylococcus aureus* isolated from bovine mastitic milk in respect of their phenotypic and genotypic characteristics more particularly resistance to methicillin (MSSA & MRSA) and other groups of antimicrobial agents, presence of methicillin resistance and other virulence genes. To carry out the study, a total of 1328 quarter milk samples from 812 animals of organized and unorganized dairy farms of Kamrup (M), Kamrup (R) and Nalbari districts of Assam were screened by California Mastitis Test (CMT) out of which 630 animals (1328 quarter) were found positive for mastitis. The 630 mastitic animals comprised 117 clinically and 513 subclinically affected dairy cows. The overall prevalence of mastitis including clinical (14.41%) and subclinical form (63.18%) mastitis in these three districts was 77.59%. Maximum number of animals had infection involving two quarters in both clinical (47.86%) and subclinical (52.44%) mastitis. Involvement of right hind quarters was higher (28.91%) than the left hind quarters (28.13%) in clinical mastitis, while it was higher in left hind quarters (29.10%) than right hind quarters (26.21%) in subclinical mastitis. Higher prevalence rate of clinical (15.36%) and subclinical (68.76%) mastitis was recorded in organized farms in comparison to clinical (12.13%) and subclinical (49.79%) mastitis in unorganized farms.

A total of 194 isolates of staphylococci were obtained from 630 bovine mastitic milk, out of which 151 (77.84%) coagulase-positive isolates identified as *Staphylococcus aureus* by phenotypic tests were confirmed genotypically by detection of *S. aureus* specific *aroA* gene by PCR. Of the 151 isolates, 54 (35.76%) were from clinical and 97 (64.24%) from subclinical mastitis and all of them produced coagulase and fermented mannitol. The prevalence of *S. aureus* associated mastitis was found to be 46.15% and 18.91% for clinical and subclinical forms, respectively. The prevalence of MRSA was 9.27% (14) as determined by cefoxitin resistance in phenotypic tests and

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confirmed by detection of *mecA* gene by PCR. The MRSA isolates were completely resistant (100%) to methicillin, cloxacillin, ceftioxin, tetracycline, streptomycin, colistin and mupirocin followed by higher degree of resistance to gentamicin and oxytetracycline (85.71% each) and moderate resistance to neomycin (50%). The MSSA isolates exhibited higher degree of sensitivity (73.72 – 100%) to tetracycline, amoxycylav, cefotaxime, ciprofloxacin, colistin, neomycin, streptomycin, mupirocin, ceftriaxone, gentamicin, cloxacillin, oxytetracycline, teicoplanin except cefepime to which they were least sensitive (54.01%). Out of 151 *S. aureus* isolates, 55 (36.42%) were multidrug resistant (MDR) which exhibited resistance against 4-12 antimicrobial agents. Among the MDR isolates, 14 (25.45%) were MRSA which showed resistance to 9-12 antimicrobial agents.

A comparative study on antimicrobial resistance spectrum of MRSA and MSSA strains was conducted by disc diffusion and E-test using 10 antimicrobial agents which included penicillin, ampicillin, oxacillin, amoxycylav, ceftioxin, cefotaxime, ceftriaxone, gentamicin, ciprofloxacin and teicoplanin. All the MRSA isolates (14) exhibited similar pattern of resistance to all the agents except cefotaxime to which three isolates showed variation. All of the 38 representative MSSA isolates were sensitive to ceftioxin, oxacillin and teicoplanin in both the tests. One to three isolates showed variation in resistance pattern to rest of the antimicrobial agents. The E-test was found to be more effective than disc diffusion method for determining sensitivity of clinical isolates to antimicrobial drugs. In phenotypic characterization, all the coagulase positive isolates (MSSA and MRSA) caused alpha or beta haemolysis on sheep blood agar and showed susceptibility to novobiocin and resistance to polymyxin B which are typical characteristics of *S. aureus*. All the 151 *S. aureus* isolates harboured the virulence associated *nuc* (thermonuclease) and *spa* (staphylococcal protein A) genes and *lukF-PV* by six (6) and *bap* by two (2) isolates as revealed by PCR assay. The isolates which showed presence of *lukF-PV* and *bap* genes were methicillin resistant strains of *S. aureus* (MRSA).

# **Molecular Detection and Characterization of Foot and Mouth Disease Virus (FMDV) and Study of Cytokine Expression in Naturally Infected Local/Crossbred Cattle from Assam**

*Derhasar Brahma*

Foot and mouth disease (FMD) is a transboundary and the most contagious disease of cloven-hoofed animals including domestic and wild ruminants and pig, and has a great potential for causing severe economic loss due to loss of production and deprivation from international trade of animal products to FMD free countries. FMDV may occur in all the secretions and excretions of acutely infected animals, including expired air. Following recovery from the acute stage of infection, infectious virus may persist in the oropharynx of some ruminants (carriers), where live virus or viral RNA may continue to be recovered from oropharyngeal fluids and cells for upto 6 months or more. In this study, besides Sandwich ELISA, molecular detection and typing of FMDV was done using multiplex Reverse Transcription Polymerase Chain Reaction (mRTPCR), Reverse Transcription Loopmediated Isothermal Amplification (RT-LAMP) and SYBR Green real-time PCR targeting 3D gene. Isolation and molecular characterization of FMDV by sequencing was done. Also, study of expression of cytokines like interferon (IFN- $\alpha$ , IFN- $\beta$ , IFN- $\gamma$ ) as well as certain interleukins (IL-1 $\alpha$ , IL-1 $\beta$ , IL-2, IL-6, IL-10 and IL-12) and tumour necrosis factor (TNF- $\alpha$ ) was estimated at mRNA level by SYBR Green real-time PCR from whole blood (White Blood cells) samples during the natural infection and during the period of persistence. This study was carried out in a total of 129 animals, comprising of 93 crossbred (vaccinated) and 36 local (non-vaccinated) cattle and additionally 12 healthy in-contact animals were taken as control animals. For carrying out this study, Tissue (n=29), whole blood (n=36) and oropharyngeal fluid (n=190) samples were collected as per standard procedure in 50% glycerol, EDTA and 0.8 M PBS/transport media, respectively. OP fluid was collected from recovered animals until complete recovery (i.e. 1st, 3rd, 6<sup>th</sup> and 9th month) from FMD infection. All the RNA extractions were done using Qiagen RNA extraction kit. We found that, out of 29 tissue samples, 20 samples were positive for serotype O, 9

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were positive for serotype A and none of the samples was positive for Asia-1 by the multiplex RT-PCR as well as RT-LAMP. FMDV could be detected in 86.21%, 100%, 100% and 100% of tissue samples by sandwich-ELISA, mRT-PCR, RT-LAMP and SYBR Green real-time PCR respectively. Sensitivity test was run using 10 fold serial dilution of RNA extracted from FMDV antigen and found that, the real-time PCR was more rapid and highly sensitive technique of all, secondly the RT-LAMP, followed by the mRT-PCR. From the follow-up cases of the FMD recovered cattle, 38 (23.75%), 47 (29.38%) and 49 (30.63%) OPF samples (n=178) were found to be positive for FMDV by the multiplex RT-PCR, RT-LAMP and SYBER Green real-time PCR respectively, indicating persistence (carriers). The SYBR green real-time PCR was very much useful for detection of persistence from the OPF samples. However, OPF (n=12) and blood (n=12) samples from all the healthy controls and blood (n=12) from persistent animals were negative for FMDV. All blood samples (100%, n=12) from the clinically FMD infected cattle were positive for FMDV. The persistence of FMDV in oropharyngeal region of cattle lasted for upto 3 to 4 months in most of the FMD infected cattle. Persistence in crossbred (vaccinated) cattle didn't last for more than 4 months. Only 2 Local non-vaccinated cattle (1.6%) was found to have persistence upto 6-7 months after infection. The overall number of persistent animals and the rate of persistence in cattle (n=129) at 1st month, 3rd month and 6<sup>th</sup> month were 32 (24.81%), 15 (11.26%) and 2 (1.6%) respectively, and was slightly higher in the local non-vaccinated compared to the crossbred vaccinated cattle. No statistical significance was observed between the two groups as the P value was found to be 0.23 (>0.05) and the Chi-square value was 5.57. The sequencing results showed that the Serotype O sequence (MZ501211-G-02-19, MZ501212-G-03-19 and MZ501213 Op) shared 98.81% identity with Pakistan isolate MN953620, 96.43% identity with India isolate KY579948.1 (Nagaland, submitted by RRC Assam) and 94.05% identity with India complete genome isolate MN983158.1; and the Serotype A sequence (MZ501214-Mg/01/19) shared 95.29% identity with Indian isolate HQ832583.1 and 94.24% identity with Bangladesh isolate KT982204. The identity range was 98.81%-96.43% and 95.29%-92.22% for type O and A respectively, based on the nucleotide sequence Blast search in NCBI. The multiple sequence alignment showed that there are some minor changes in the nucleotide sequences with the consensus sequences. There were nucleotide insertions in the 3953 and 3954 positions in two of the query sequences of FMDV type O. Whereas, in FMDV type A, there were nucleotide insertions at 3807, 3813-3815 and 3841 positions and deletions at 3771 and 3874 positions of the nucleotide sequences. The result from this study shows that cytokine genes had general trend of upregulation during acute infection and decreased level of expression or down regulation during persistence. Cytokines in blood were generally upregulated in both acute infection and persistence, but compared to acute, there was decreased mRNA level of expression of cytokines during persistence except the down regulation of IFN- $\beta$ , IL-2 and IL-6, whereas, all but IFN- $\alpha$  and IL-1 $\alpha$  were down regulated in OPF during persistence. These cytokines may have certain role in persistence of FMDV by suppression of immune response and also by having anti-

inflammatory or immunomodulatory response in carrier cattle. Thus, from this study, we can conclude that, molecular detection techniques are the most sensitive and specific techniques for detection of FMDV and particularly for diagnosis of persistence from OPF samples. Persistence occurred in 32 cattle (25%) after 1st month of the FMDV infection, out of which the proportion of local non-vaccinated cattle was slightly higher. And that cytokines may have a role in persistence of FMDV in cattle.

## **Biofilm Production, Associated Genes and Antimicrobial Resistance of *Escherichia coli* Isolated from Bovine Mastitis**

*Himasri Das*

Livestock production sector acts as one of the greatest contributors towards economic development of the country. Mastitis is considered to be one of the most common diseases of high yielding dairy cows which can cause decline in the milk production that ultimately leads to great economic loss in both developed and developing countries. Bovine mastitis can be divided into two types, clinical mastitis and subclinical mastitis. The present study was undertaken on phenotypic and genotypic detection of biofilm producing *E. coli* isolated from bovine mastitic milk and their antimicrobial resistance profile against commonly used selected groups of antibiotics. To carry out the study, a total of 560 quarters from 140 animals of both organized and unorganized dairy farms in and around Guwahati were screened for mastitis by California Mastitis Test (CMT) out of which 108 animals were found positive for mastitis. The overall prevalence of mastitis including clinical (15%) and subclinical form (62.14%) in both types of farms was 77.14%. In quarter wise distribution of mastitis, involvement of hind quarter was found to be more frequent. A total of 33 *E. coli* were isolated from 108 milk samples of mastitic dairy cows. All the isolates were screened for biofilm producing ability when tested by using on qualitative as well as quantitative detection methods viz., Congo red agar, Christensen tube and Tissue culture plate methods and all of them were found to be biofilm producers. All the *E. coli* isolates were tested for presence of biofilm associated genes, viz., *csgA*, *fimH* and *luxS*. The *csgA* gene was detected in 30 (90.90%) isolates, *fimH* in 31(93.93%) isolates and *luxS* was found in 30 isolates (90.90%). On relative quantification of mRNA expression of *csgD* gene revealed that the  $\Delta$ CT value is significantly and negatively associated with biofilm production (P value<0.05). The *E. coli* isolates showed 100% sensitivity to Gentamicin, Neomycin and Amoxicillin+Sulbactam followed by Streptomycin (96.97%), Colistin (84.85%), ciprofloxacin and Ceftriaxone+Sulbactam (72.73% to each), Cefoperazone+ Sulbactam (69.70), Enrofloxacin and amoxycillin (63.64% to each) and Ceftriaxone (39.39%). However 100% resistance was observed for Cloxacillin

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followed by Ampicillin (96.97%) and Sulfadiazine (90.91%) on Disc diffusion test. In the present study, a total of 15 (45.45%) isolates were found to be multidrug resistant. Among all the MDR biofilm producing isolates, 6 were strong biofilm producers, 5 were moderate and 4 were weak biofilm producers and a significant correlation has been found between the strength of biofilm production and presence of MDR isolates ( $p < 0.01$ ). Our present finding has shown that the MIC values of Ceftriaxone, Amoxicillin, Gentamicin, Streptomycin were significantly correlated with strength of biofilm ( $P \text{ value} < 0.05$ ). Out of 33 *E. coli* isolates tested, 18 (54.54%) were confirmed as ESBL producers based on double disk synergy test (DDST) and E-test. Further genotypic characterization of ESBL producing *E. coli* showed that ESBL encoding gene blaCTX-M was detected in 13 (39.39%) isolates with a product size of 585bp, blaSHV gene was detected in 3 (9.09%) isolates with a product size of 393bp and blaTEM gene was detected in 6 (18.18%) isolates with a product size 506bp.

## **Phenotypic and Molecular Characterization of *Riemerella anatipestifer* Isolates from Ducks**

*Monuj Kr. Doley*

*Riemerella anatipestifer* cause one of the most economically important infectious diseases among the domesticated duck population. The present study was conducted to isolate *R. anatipestifer* and also to phenotypic and molecular characterization of the isolates. During the study period, 27 suspected field outbreaks were attended in five district of Assam. A total of 624 samples were collected and processed for isolation followed by phenotypic and molecular characterization. All confirmed isolates (n=95) were screened for two important virulence genes *ompA* and *cam* gene. Further, the confirmed field isolates were also subjected for antimicrobial resistant pattern against 28 most commonly used antimicrobial agents to determined suitable antimicrobial regime. Pathogenicity test was also conducted from isolates recovered from dead ducks in suitable host system.

On bacteriological examination, 121 isolate (19.39%) could be recovered based on phenotypic characteristics (cultural, morphological and biochemical). Phenotypically, highest bacteria could be isolated from brain and heart tissue (28.57%) followed by spleen and liver (26.19%) and least from ocular swab (12.50%). All the isolates produced small, smooth, circular, mucoid, glistening and dew drop like colonies on blood agar under micro-aerophilic condition for 18-24hours. The colonies were found to be non haemolytic on blood agar except 4 isolate (11.12%), watery, discrete, translucent with characteristics odour of culture. Biochemically, all the isolates showed positive for catalase and oxidase test (100%), 97 isolates for gelatin liquefaction test (80.16%) whereas found negative for indole, methyl red, Vokes-Proskauer, H<sub>2</sub>S, ornithine decarboxylase *etc.* On sugar fermentation tests, 10 isolates revealed positive for trehalose and xylose (8.26%), 7 isolates for lactose (5.78%) test. Among the phenotypically identified suspected isolates only 95 isolates (78%.51) could be recovered through PCR assay targeting *16S rRNA*, ERIC sequence and *gyrB* gene with equal positivity.

Phylogenetic analysis of the representative isolates based on species-specific *16S rRNA* gene revealed formation of single clade with two reference strains HXb2 (CP011859.1) and D-743 (AY871831.2) of China. Moreover, within the clade four

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isolates (ASC/AAU/RA5, ASDi/AAU/RA4, ASS/AAU/RA3 and ASK/AAU/RA1) formed one sub-clade, whereas ASD/AAU/RA2 formed another sub-clade with HXb2 and D-743 strains. The analysis revealed that *R. anatipestifer* circulating in Assam is closely related to the Chinese strains of the organism and at least two different strains are prevalent in the study area. The pairwise sequence identity analysis of *16s rRNA* gene sequences among the isolates were between 96.5-100 % with divergence ranged from 0 to 3.5 % among the strains. Based on pairwise sequence identity, all isolates ASC/AAU/RA5, ASDi/AAU/RA4, ASS/AAU/RA3 and ASK/AAU/RA1 formed one molecular sub-group whereas isolate ASD/AAU/RA2 was far from this molecular group. Among all the stains of *R. anatipestifer*, the largest divergence (3.5 %) was exhibited by the isolate ASD/AAU/RA2. There were no significant divergence among ASC/AAU/RA5, ASDi/AAU/RA4, ASS/AAU/RA3 and ASK/AAU/RA1, whereas ASD/AAU/RA2 showed 1.7% divergence when compared with other four isolates from Assam. These findings additionally support the phylogenetic analysis which is suggestive of circulation of at least two different strains in Assam.

Similarly, phylogenetic analysis targeting tree *gyrB* gene elicited that all the five *R. anatipestifer* isolates of Assam forms one clade in the cluster 1 with five reference Chinese strains RA9913 (JN969056), WJ4 (CP041029), XG19 (CP076675), RA-CH-1 (CP003787), and HXb2 (CP011859). This analysis revealed that *R. anatipestifer* circulating in Assam are closely related to Chinese strains. The Pairwise sequence identity analysis of *gyrB* gene sequences of *R. anatipestifer* were between 92-100% and revealed that all the isolates of Assam formed one molecular sub-group with Chinese strains. The pairwise identity among the isolates of Assam is between 99-100%. These findings additionally support that the *R. anatipestifer* strains circulating in Assam has close resemblance with *R. anatipestifer* strains of China.

Pathogenicity trial with pathogenic isolates in duckling revealed highest mortality within 48-72 hours (53.34%) followed by 24-48 hrs (33.34%) post inoculation (pi) and bacterium could be reisolated from the death duck.

The antimicrobial (28) resistant pattern of field isolates ( $n=95$ ) revealed 100 per cent sensitive to enrofloxacin, ciprofloxacin, cefotaxime, sulphadiazine and sulphafurazole whereas piperacillin+tazobactam, methicilin, rifampicin, colistin were found to be 100 per cent resistant. All the isolates of *R. anatipestifer* displayed an expanding resistance pattern to number of antibiotics such as 88.89% to clindamycin, 81.48% to oxytetracycline, 85.18% to ofloxacin, 70.37% to streptomycin, 51.85% to chloramphenicol, 37.03% towards cefixime, 29.62% towards gentamicin *etc.* The group wise antibiotic resistant patterns of *R. anatipestifer* isolates revealed that most of the isolates were resistant to tetracycline (81.46%) group followed by penicillin (74.69%), Phenicols (51.84%), aminoglycsides (40.74%) and flouroquinolones (28.39%) *etc* while highest susceptibility were recorded towards carbapenems (100%) followed by Sulphonamides (95.07%), cephalosporins (90.13%),, quinolones (81.49%), and macrolids (77.77%).

The molecular screening of the field isolates towards virulent gene through PCR assay revealed that all the isolates were found positive for conserved *ompA* gene (100%) whereas only 4 isolates (4.25%) were found to be positive for *cam* gene.

## **Efficacy of Selected Herbal Preparations against Gastrointestinal Nematodes with Special Reference to *Haemonchus contortus* in Goats**

*Neelakshi Deka*

The present study was carried out to ascertain the prevalence of gastro-intestinal nematode parasites of goats in and around the undivided Kamrup district of Assam and to estimate the anthelmintic efficacy of the three selected indigenous herbal plants *viz.*, *Butea frondosa* (Polakh), *Carica papaya* (Omita) and *Corchorus fascicularis* (Morapat) by *in-vitro* and *in-vivo* evaluation in goats naturally infected with gastro-intestinal nematodes. The study was conducted for a period of one-year w.e.f. October 2020 to September 2021 in Kamrup Rural and Metro districts of Assam.

A total of 576 faecal samples were collected for the study. Faecal examination by Flotation Technique and Modified McMaster Method was carried out and overall prevalence of gastro-intestinal nematodes was recorded to be 63.89 %. Month-wise prevalence of gastro-intestinal nematode was also recorded where July month recorded the highest prevalence of 91.84 percent and February recorded the lowest prevalence of 31.81 percent. Monsoon season recorded the highest prevalence of 84.28 percent and winter season recorded the lowest prevalence of 35.06 percent. Among the three breeds of goat examined during the present study, Assam Hill goats recorded highest prevalence of 69.80 percent. The 6 months to 1 year age-group animals showed highest prevalence of 76.42 percent and female animals (doe) recorded the highest prevalence of 76.34 percent. The positive faecal samples were put in faecal culture for development of nematode larvae which revealed *Haemonchus* sp., *Trichostrongylus* sp., *Oesophagostomum* sp. and *Strongyloides* sp. larva in the study area. Polymerase chain reaction (PCR) was employed for molecular identification of *Haemonchus contortus* which showed a distinct band at 265 bp.

Three types of leaf extract *viz.*, ethanolic, hydroethanolic and aqueous extracts of each of three plants were prepared. The percent yield of ethanolic extract of *B. frondosa*, *C. papaya* and *C. fascicularis* was found to be 11.02, 7.81 and 13.72 % (w/w) respectively. For hydroethanolic extract the percent yield was found to be 12.81, 15.19 and 19.60 % (w/w) respectively and the percent yield of aqueous extract was found to be

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16.02, 35.28 and 32.87 % (w/w) respectively. Phytochemical analysis of ethanolic, hydroethanolic and aqueous extract of leaves of *B. frondosa*, *C. papaya* and *C. fascicularis* revealed the presence of flavonoids, glycosides and triterpenes. Acute toxicity studies with ethanolic, hydroethanolic and aqueous extracts of the leaves of *B. frondosa*, *C. papaya* and *C. fascicularis* did not show any behavioural change or gross abnormality within 48 hours @ 2000 mg/kg body weight in mice. The extracts were considered to be safe up to a maximum dose of 2000 mg/kg.

Three different concentrations viz., 50, 100 and 200 mg/ml was used for all the nine leaf extracts prepared from the three plants. Among the three plants studied in *in-vitro* trial, *B. frondosa* was observed as the best plant having *in-vitro* anthelmintic efficacy. Based on the findings of the *in-vitro* studies, the hydroethanolic extract of *B. frondosa* was selected to undergo *in-vivo* evaluation in goats naturally infected with *Haemonchus* sp., *Trichostrongylus* sp., *Oesophagostomum* sp. and *Strongyloides* sp. using two doses, 250 and 500 mg/kg body weight. At 250 mg/kg body weight, the percent efficacy was 80.18 % and 72.79 % on Day 7 and 14 respectively, and at 500 mg/kg body weight the percent efficacy was 69.46 % and 73.12 % on Day 7 and 14 post-treatment respectively. The pulverized leaves of *B. frondosa* was also incorporated in urea-molasses-block (MUMB, Herbal Anthelmintic) and fed to goats naturally infected with *Haemonchus* sp., *Trichostrongylus* sp., *Oesophagostomum* sp. and *Strongyloides* sp. The anthelmintic efficacy upon feeding of medicated urea molasses block (MUMB, Herbal Anthelmintic) incorporated with *B. frondosa* was found to have 88.16 % and ii 86.34 % efficacy on Day 7 and 14 post-treatment respectively. Ivermectin was used as the standard anthelmintic drug which gave 96.90 % and 93.79 % efficacy on Day 7 and 14 post-treatment respectively.

Haemato-biochemical studies of treated goats under the *in-vivo* trial showed significant improvement in haemoglobin, packed cell volume, total erythrocyte count and total leukocyte count in groups fed with hydroethanolic extract of leaves of *B. frondosa* and MUMB (incorporated with *B. frondosa*) from Day 0 pre-treatment to Day 28 post-treatment. Total protein and albumin concentration improved significantly in groups treated with hydroethanolic extract of *B. frondosa*. Aspartate transaminase and alanine transaminase was found to improve significantly in groups treated with hydroethanolic extract of leaves of *B. frondosa* and MUMB (incorporated with *B. frondosa*) from Day 0 pre-treatment to Day 28 post-treatment.

*B. frondosa* leaf extract and MUMB was found to possess significant *in-vitro* and *in-vivo* anthelmintic activity and improved the haemato-biochemical parameters substantially during the present study. This indicates that *B. frondosa* has the potential to be used as herbal anthelmintic. MUMB with herbal incorporation can be recommended to be used for the control of gastro-intestinal nematodosis in goats.

This indicates that the extract of leaves of *B. frondosa* is a potent and effective herbal anthelmintic. Incorporation of the herbal leaves as powder form in medicated urea molasses block (MUMB, Herbal Anthelmintic) can be used for the control of gastro-intestinal nematodes in goats. The conventional use of synthetic anthelmintics

has led to the development of anthelmintic resistance in goat farms not only in Assam but also India and the world as a whole. Therefore, newer anthelmintics need to be developed to overcome the problem of anthelmintic resistance and control of gastrointestinal nematode parasites of goat.

## **Tick and Tick-Borne Parasitic Diseases of Dog Prevalent in and Around Guwahati, Assam**

*Pallabi Devi*

The study was conducted to record the prevalence of ticks on dog and haemoparasites borne by them. Molecular identification and characterization of the prevalent tick species was also done in order to know their taxonomic status and evolutionary relationship. The study was conducted from March, 2021 to February, 2022. 1440 dogs were examined for the presence of ticks on their body. Out of 1440 dogs, 986 (68.47%) were found to be infested with ticks. 504 (35.00%) ticks were identified as *Rhipicephalus sanguineus*, 260 (18.06%) were identified as *Haemaphysalis bispinosa* and 222 (15.42%) were found to be mixed infestation. The highest prevalence of *R. sanguineus* ticks during August (61%) and the lowest during February and December (25%). Highest prevalence of *H. bispinosa* was recorded during August (26.67%) and the lowest during February and January (10.00%). Mixed infestation was highest during August (35.0%) and lowest during December (5.0%). The month-wise prevalence was found to be non-significant by statistical analysis (P value: 0.964948). The highest prevalence of ticks was recorded during the monsoon (95.42%) followed by the post-monsoon and the lowest during winter (37.5%). Statistically season has no significant influence on the prevalence of ticks on dogs (P value: 0.6541). The highest percentage of dogs infested with *Rhipicephalus* and *Hemaphysalis* tick at the age of 2-3 years (53.49%) and 6 month to 1 year (18.24%) respectively and lowest in 9-10 years (0%). The prevalence of ticks was significantly influenced by the age of dogs (P: 2.28695E-08). Labrador breed of dogs (98.23%) were found to be most infested by ticks followed by Local/mongrel (91.30%) and the least in St. Bernard (7.14%). The breeds of dog were found to be significantly influence the prevalence of ticks (P: 2.1666E-17). The female dogs showed higher prevalence of ticks (52.54%) than their male counterparts (47.46%). The most preferred site of attachment of the ticks on the dog's body was ears (28.39%) followed by head (18.56%) and paws/toes (17.64%). Morphological study of both the prevalent tick species were done and characteristic diagnostic features were figured out with photograph. Molecular identification and characterization of prevalent tick species were done by amplification of the 16S rRNA gene by PCR. Phylogenetic analyses by neighbor joining method were performed and

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the pair wise distance of 16S rRNA were done with MEGA X software. The pair wise distance study revealed that the *R. sanguineus* strain AS/AAU/RS-01 was found to be 100% identical to the isolates of tropical lineages and is 6.4-7.5% divergent with the isolates of temperate lineages. *H. bispinosa* strain AS/AAU/HB-01 formed the clade with other isolates of *H. bispinosa*. The closely related isolates of AS/AAU/HB-01 were observed to be Chipahikhola isolate, Itanagar isolate and Arunachal Pradesh isolates. The pair wise distance of AS/AAU/HB-01 showed divergence of 0-3.6% with other isolates of *H. bispinosa* and with other species of *Haemaphysalis* was between 9.3-14%. 4119 numbers of Giemsa's stained thin blood smears were examined under the light microscope for presence of tick-borne hemoparasites. The prevalent of five tick borne haemoparasites in dogs were recorded were *Babesia gibsoni* (10.34%), *Babesia canis* (0.92%), *Hepatozoon canis* (0.39%), *Anaplasma (Ehrlichia) platys* (0.12%) and *Ehrlichia canis* (0.22%). Out of 526 positive blood samples, 100 randomly selected positive samples were confirmed with PCR by amplification of 18S rRNA gene for (*B. gibsoni*, *B. canis*, *H. canis*) and 16S rRNA gene for (*A. platys* and *E. canis*) and found that PCR shows more sensitivity than light microscopy. Overall prevalence of tick borne haemoparasites, irrespective of season, breed, age and sex is recorded to be highest in the month of July (16.92%) followed by September (16.19%) and lowest in the month of February (4.18%). The highest prevalence of *Babesia gibsoni* was noticed in Labrador breed (12.93%) followed by local/mongrel dogs (11.53%) while *Babesia canis* was mostly encountered in Lhasa apso dogs (2.63%) followed by Boxer breed (2.38%) of dogs. Similarly, Pomeranian breed was found to be mostly infected by *Hepatozoon canis* (1.96%) followed by Doberman (1.55%) dogs. On the other hand, the rickettsial organism *Anaplasma platys* affect mostly Shitzu (3.85%) dogs followed by Dalmatian breed of dog (2.56%) and *Ehrlichia canis* was found to affect mostly Lhasa apso (2.63%) followed by Boxer dogs (2.38%). It has been noticed that out of all 18 breeds of dog in the present study, Labrador breed of dog is found to infect most by different haemoparasites followed by local/ mongrel dogs. Female dogs were recorded to be more affected than the male dogs. Statistical analysis revealed that sex of dog has significant influence on the prevalence of tick-borne hemoparasites (P: 0.040134). The highest prevalence of hemoparasites was seen in 1-2 years of age (17.70%) followed by <1 year (16.32%) and 2-3 years (14.88%) of age. The lowest prevalence was observed in 11-12 years of age (2.86%) and mixed infection of *Babesia canis* and *Babesia gibsoni* is found to be highest of all other combination of infection.

## **Ixodid Ticks Their Acaricide Resistance and Tick-Borne Haemoparasites in Cattle**

*Rabeya Begam*

Present study with an aim to obtain current information on the prevalence and acaricidal resistance status in ticks and prevalence of haemoparasitic infection in cattle in and around Guwahati. Prevalence of *Rhipicephalus (Boophilus) microplus* was recorded as 49.27% throughout the year in all the breeds of cattle and *Haemaphysalis bispinosa* as 2.72% was recorded in a few Zebu cattle. Overall tick prevalence was 51.99% in cattle (n=777). Prevalence of tick infestations was highest (74.04%) in Zebu in cattle, followed by crossbred Holstein Friesian (52.87%) and lowest (42.27%) in crossbred Jersey. Season-wise, overall infestation was found highest in Monsoon (67.33%) followed by Pre-monsoon (58.85%), Post-monsoon (43.18%) and lowest in Winter (32.18%) season. Age-wise, highest prevalence rate was observed more in 1-5 years' age group of cattle (58.62%) followed by >5 years (50.81%) and lowest (39.65%) in calves. Breed-wise, zebu cattle (74.04%) were found more susceptible to tick infestation followed by crossbred Holstein-Friesian cattle (52.87%) and crossbred Jersey (42.27%). Sex-wise, females were found more susceptible (53.71%) than the males (45.22%). On the basis of distribution of ticks on the body of cattle irrespective of breed type, highest infestation was recorded from neck (94.30%) followed inguinal region (71.03%), brisket (67.33%), head (50.24%), leg (40.84%) and tail (11.88%). On the basis of types of farm irrespective of breed type, infestation was recorded higher in unorganized farm (80.50%) compared to organized farm (6.25%). Acaricide resistance test conducted through AITDD, AIT and LPT showed resistance against the ticks of unorganized farm of Ganeshnagar area of Basistha. AITDD revealed 90 per cent resistance against cypermethrin and 86.00% resistance against deltamethrin. AIT revealed LC<sub>50</sub> and LC<sub>95</sub> values as 62.08 ppm and 122.28 ppm for deltamethrin, 227.08 ppm and 473.70 ppm for cypermethrin. LPT revealed LC<sub>50</sub> and LC<sub>95</sub> as 30.98 ppm and 70.43 ppm for deltamethrin, 161.09 ppm and 356.24 ppm for cypermethrin. Both AIT and LPT showed level 1 resistance in the *R. (B) microplus* ticks. Prevalence of haemoparasites on blood smear examination revealed *Babesia bigemina* (0.51%), *Anaplasma marginale* (11.45%) and *Theileria orientalis* (51.99%) which was subsequently confirmed by PCR. The overall prevalence of haemoparasites of cattle in

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and around Guwahati was recorded as 63.96%. Season-wise prevalence was found to be highest in Monsoon (86.85%) followed by Pre-monsoon (72.92%), Post-monsoon (55.30%) and lowest in Winter (32.67%) season. Age wise, the highest prevalence was seen in 1-5 years' age group of cattle (82.07%) than >5 years (75.06%) and lowest (10.34%) in calves. Breed-wise, prevalence of haemoparasites was recorded to be highest in crossbred Holstein-Friesian (65.59%) followed by crossbred Jersey (64.71%) and Zebu cattle (57.69%). Females were found more susceptible to haemoparasitic infection (69.83%) than the males (40.76%). On the basis of types of farm irrespective of breed type, haemoparasitic infection was recorded higher in unorganized farm (93.29%) and lower in organized farm (17.33%). PCR amplified the haemoparasite DNA of *B. bigemina*, *A. marginale* and *T. orientalis* which showed clear band at 1124 bp, 714 bp and 776 bp, respectively. The present study revealed *R. (B). microplus* as the predominant tick infesting cattle of the study population. Acaricide resistance test conducted through AITDD, AIT and LPT showed development of resistance against the ticks of unorganized farm of Ganeshnagar area of Basistha. *B. bigemina*, *A. marginale* and *T. orientalis* were present in cattle of the study population. Present study also revealed that haemoparasites are widely prevalent in cattle throughout the study area indicating haemoparasites possess a major constraint for the well-being of the cattle health in Assam.

# Pathology and Molecular Diagnosis of *Helicobacter* Infection in Pig

*Kongkon Jyoti Dutta*

*Helicobacter* is a zoonotic bacterium that has been associated with gastritis and ulcerative lesion in the stomach of pig. Prevalence of *Helicobacter* infection in pig was determined from four districts of Assam during the period from July, 2021 to June, 2022. The prevalence of *Helicobacter* infection was found to be 39.9% and 45.67% by RUT and PCR test, respectively. The age wise prevalence of *Helicobacter* infection revealed highest in adult pigs 42.37% (RUT) and 48% (PCR) in comparison with piglet 23.07% (RUT) and 16.66% (PCR). Among different farms the highest prevalence was recorded in unorganized farms 45.53% (RUT) and 52.17% (PCR) in compared to organized farms 32.96% (RUT) and 37.10% (PCR). The presence of HLOs in different regions of the stomach by RUT was recorded as Parsoesophagea (1.48%), Cardia (2.95%), Fundus (15.27%), and Pylorus (20.27%). The maximum positivity was recorded in pylorus and fundus region with 20.27% and 15.27% respectively. The presence of HLOs in different grades of gastric macroscopic lesions was determined. The positivity of HLOs in different grades of gastric macroscopic lesions recorded as: 1+ (Early or mild) (28.12%), 2+ (Severe) (37.03%), and 3+ (more severe+ ulcers) (56.89%). The maximum positive RUT was detected in Grade 3+ (58.89%). HLOs were detected by brush cytology from the mucosal surface satined with Giemsa and Gram's stain in 22.66% and 16.74% of the samples respectively. The gross lesions of gastritis were recorded in 203 (58%) stomachs out of 350 pig carcasses examined. The present investigation recorded early or mild gastric lesions (1+) in 31.53%, severe lesion (2+) in 39.90% and more severe lesions and ulceration (3+) in 28.57% of the stomach examined grossly. The recorded lesions were various grades of lesions as thickening of the gastric wall, corrugation of the gastric folds, congestion and haemorrhages, necrosis and sloughing of the gastric mucosa, erosions and ulceration in the paroesophagea as well as glandular regions of the stomach. The frequency of various histopathological lesions in affected stomach were Hyperkeratosis (17.28%), Parakeratosis (14.81%), Epithelial hyperplasia (44.44%), Glandular degeneration (60.49%), Vacuolation of glandular epithelium (56.79%), Lymphoid follicle (62.96%), Inflammatory cell infiltration (Neutrophil (32.09%), Lymphocyte (45.67%), Eosinophil (23.45%), Macrophage

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(28.39), Plasma cell (25.92%), Sloughing & erosion (53.08%), Ulcer, Congestion and Haemorrhages (39.50%), Glandular abscess (9.87%), Fibrosis (4.93%), Metaplasia and Dysplasia (3.70%), and Detection of *Helicobacter* (9.87%). Ultrastructurally, *Helicobacters* with bacillary morphology, inflammatory cells on the gastric mucosa and biofilm formation by coccoid form of *Helicobacters* were detected. PCR analysis of the gastric samples showed the presence of *Helicobacter* spp in 37 (45.67%) and *Helicobacter suis* in 17 (20.98%) samples. PCR detection rate was found to be higher from the pylorus and fundic region and severe gastric lesions of the stomach. To study the zoonotic potential of *Helicobacters*, a total of 30 saliva samples from pig farmers were subjected for PCR out of which *Helicobacter* spp. was detected in 8 numbers of samples. Further, *Helicobacter suis* (2) and *Helicobacter pylori* (3). Phylogenetic analysis revealed that *Helicobacter suis* detected from pig handlers and pig stomach samples shares above 99% identity suggesting zoonotic transmissions of *Helicobacters* from pig to human.

## **Pathomorphological and Molecular Diagnosis of Infectious Bursal Disease**

*Muzaharul Islam*

The present investigation was carried out to know the pathomorphology of Infectious Bursal Disease in different organized and un-organized poultry farms in and around the Guwahati city, Kamrup district, Assam.

Altogether 1650 birds were necropsied, out of which 1279 birds from 29 different outbreaks were diagnosed as suspected of IBD based on gross lesions observed. Clinical signs commonly recorded were vent pecking, dullness, depression, anorexia, ruffled feathers and yellowish white diarrhea.

In gross pathological study, bursa of Fabricius were found to be invariably affected with lesions like swelling, edema and hemorrhage. Few bursa of Fabricius showed atrophy. Moderate to severe haemorrhages in the breast and thigh muscle were consistently observed. The kidneys were enlarged and mottled with whitish pale colour appearance. Hemorrhagic lesions were also noticed in extra bursal lymphoid organs like spleen, thymus and caecal tonsils.

Histopathologically, there were mild to severe depletion of lymphocytes in the bursa of Fabricius, spleen, thymus and caecal tonsils. Heterophilic infiltrations were also consistently observed in these organs. Complete depletion of lymphocytes with formation of cystic cavity were noticed in some bursal follicle. Marked thickening of the inter-follicular space with proliferated fibrous connective tissue were another characteristic bursal lesion observed. Muscle sections revealed haemorrhages and necrosis. Kidney showed degenerative changes and necrosis in proximal and distal convoluted tubules. There were glomerular shrinkage in few cases. Degenerative changes of the hepatocytes were the commonly observed histopathological changes in liver.

In scanning electron microscopic study of bursa of Fabricius, moderate to severe erosion and ulceration of mucosal plica and exposure of reticular fibers were noticed after exuviations of epithelial and other cells were noticed. Button like depressed structures were seen in follicles and some follicles appeared as empty craters due to complete lymphocytic depletion. Spleen and thymus also showed moderate to severe

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lymphocyte depletion characterized by presence of homogenous mass. In transmission electron microscopic, spherical virus particle without a clear membrane were observed in the cellular debris of the cytoplasm of the follicular cells. Mitochondrial changes like cristolysis were also recorded.

The disease was confirmed by detection of viral antigen and viral nucleic acid in 165 representative samples by Indirect IPT and 612 representative samples by RT-PCR.

# **Effect of Selenium and Zinc-Oxide Nanoparticles on Cryopreserved Semen Quality and Fertility of Assam Hill Goat**

*Sayed Nabil Abedin*

Nanoparticles (NPs), due to their smaller size and unique surface properties can be incorporated into a variety of reproductive biology procedures. The present investigation was carried out from September, 2021 to July, 2022 on four (4) Assam Hill Goat bucks (10 ejaculates per buck) to investigate the effect of supplementing zinc oxide (ZnO) and selenium (Se) NPs in TRIS extender on seminal attributes, lipid peroxidation (LPO) profile, antioxidant enzyme activities *viz.*, superoxide dismutase (SOD), catalase (CAT) and Glutathione-S-transferase (GST), relative heat shock protein (HSP) mRNA levels and fertility of cryopreserved Assam Hill Goat semen. The size morphology and zeta potential values of ZnO and Se NPs were evaluated. Qualified semen samples were divided into five (5) aliquots and then diluted in TRIS extender containing ZnO and Se NP supplementation at different concentrations (T0: control; T1: 0.1mg/mL ZnO NPs; T2: 0.5 mg/mL ZnO NPs; T3: 0.5 µg/mL Se NPs and T4: 1 µg/mL Se NPs). Diluted semen was packed in 0.25 mL straws and then stored in liquid nitrogen. After thawing, post-thaw attributes *viz.*, motility, viability, morphology, plasma membrane integrity (PMI), DNA integrity and mitochondrial membrane potential (MMP) were evaluated. The different treatment groups were also checked for potential NP internalization under transmission electron microscope (TEM). Lastly, straws from the best among the ZnO and Se NP treatments were used for artificial insemination (AI) in does (n=35) synchronized by Ovsynch protocol.

Results showed that ZnO and Se NPs were poly-crystalline in nature with particle size below 100 nanometers. The evaluated post-thaw sperm *in vitro* attributes were significantly ( $p<0.05$ ) higher in groups containing ZnO and Se NPs supplementation in comparison to control group. Overall, ZnO NPs @ 0.1 mg/mL (T1) had significantly ( $p<0.05$ ) higher post-thaw sperm *in vitro* attributes in comparison to Se NPs @ 1 µg/mL. ZnO and Se NP supplementation also significantly ( $p<0.01$ ) lowered cryocapacitated (B and AR pattern) spermatozoa in comparison to control. The antioxidant enzyme activities (SOD, CAT and GST) were significantly ( $p<0.001$ ) higher

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in T1 in comparison to T0. The LPO was significantly ( $p < 0.001$ ) lowered in T1, T2, T3 and T4 in comparison to T0. The leakages of functional enzymes *viz.*, aspartate aminotransferase (AST), alanine aminotransferase (ALT) and lactate dehydrogenase (LDH) were significantly ( $p < 0.001$ ) lower in T1 in comparison to other groups. Post-thaw sperm motility and MMP had a highly significant ( $r = 0.580$ ,  $p < 0.05$ ) association in T1. SOD ( $r = 0.445$ ) and CAT ( $r = 0.949$ ) had a highly significant ( $p < 0.05$ ) correlation with sperm motility in T1. No internalization of ZnO and Se NPs were observed under TEM. HSP70 and HSP90 mRNA levels were significantly ( $p < 0.001$ ) higher in T1 in comparison to other groups. HSP70 and HSP90 expression levels had a significant ( $p < 0.05$ ) positive correlation with motility in group T1. No significant ( $p > 0.05$ ) differences in pregnancy rates following AI were recorded among the different treatment groups in comparison to control. In conclusion, extender supplemented with 0.1 mg/mL ZnO NPs improved post-thaw semen quality of cryopreserved Assam Hill goat spermatozoa consequently by lowering lipid peroxidation and increasing expression of cryostress associated heat shock genes.

**Keywords:** Zinc oxide, Selenium, Nanoparticles, Assam Hill Goat, Semen quality, Heat shock proteins, lipid peroxidation

## **Circulation of Japanese Encephalitis Virus in Mosquito Vectors, Amplifying Hosts and Its Association with Human Incidences in Assam**

*Aditya Baruah*

Japanese encephalitis (JE) is a re-emerging mosquito-borne flaviviral zoonotic disease and a major cause for concern to childhood mortality and morbidity in countries of Southeast Asia including India. The disease has appeared in sporadic as well as epidemic forms since 1976 in Assam. The present study was envisaged to study the sero-prevalence of JE in pigs, the density pattern of mosquito vectors in JE endemic localities and to draw an association between the occurrence of JE in humans with serological studies in pigs and mosquito density.

A total of 200 blood samples of pigs were collected during the study period (June-September, 2021) from Lakhimpur district of Assam. Out of these screened samples, 19% were found positive for antibodies against JEV. The sero-prevalence in different months was observed to be: June (16%), July (28%), August (20%) and September (12%). Sero-prevalence in Urban areas and Peri-Urban areas was observed to be 17.5% and 20%, respectively. The sero positivity in pigs based on their rearing practice in study area was recorded highest in Semi Intensive (25%) followed by intensive (17.5%), tethering (13.33%) and least in scavenging (10%). The rearing of other animals like ducks, poultry had significant relationship on JE seropositivity in pigs. The presence of stagnant water, water tanks, paddy field in the proximity of the pig farms showed higher sero-positivity ( $p < 0.01$ ).

A total of 8 different species of mosquitoes were identified of which the most predominant was recorded to be *Culex tritaeniorhynchus* (26.58%) followed by *Mansonia* spp. (15.93%), *Culex vishnui* (15.43%), *Culex quinquefasciatus* (14.67%), *Culex gelidus* (10.60%), *Culex fuscocephala* (10.50%), *Culex whitmorei* (4.01%) and *Anopheles* spp. (2.23%).

The envelope E gene of JEV virus was detected from tonsils of pig, pig blood samples, aborted foetus and two pools of mosquitoes viz. *Culex tritaeniorhynchus* and *Mansonia* spp.

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A positive correlation was observed between human JE cases and JEV seroprevalence in pigs of Lakhimpur district of Assam where virus was also found to be circulating amongst the collected mosquito indicating an association between them.

# **Occurrence of Extended Spectrum Beta-Lactamase Producing *Escherichia coli* and *Klebsiella pneumoniae* in Commercial Chicken of Urban and Peri-urban Farms of Guwahati**

*Chandrani Goswami*

Spread of ESBL producing *E. coli* and *K. pneumoniae* to humans through food substances, including chicken is of major importance as beta lactam are the most favored class of antibiotics for the treatment of bacterial infection. In Assam, although chicken rearing has traditionally been popular, knowledge, attitude and practices (KAP) indicators of the farmers about antimicrobial usage and antimicrobial resistance (AMR) are lacking. The present investigation was carried out from April, 2021 to September, 2022 to collect baseline data on chicken farmers' KAP on antibiotics, their usage and AMR, study the occurrence of ESBL producing *E. coli* and *K. pneumoniae* in chicken by phenotypic and molecular methods, study the genetic diversity among representative *E. coli* and *K. pneumoniae* isolates based on 16S rRNA sequencing and to prepare ESBL producing *E. coli* and *K. pneumoniae* prevalence map in urban and peri-urban commercial chicken farms of Guwahati. A total of 12 locations from urban and peri-urban areas and a total of 10 chicken meat selling markets from urban areas of Guwahati were selected for the study.

Baseline data revealed that most of the farmers were educated up to higher secondary (36.11%) level. In-contact animals, including cows, pigs, goats, ducks, pigeons, fish, cats, and dogs were recorded in 72.22% of total farms. Most farmers (38.89%) sell farm waste after completion of single batch of broiler rearing. Dumping (55.56%) was the most common practice for disposal of dead chickens. Farms (27.77%) were found to be dirty. Urban and peri-urban commercial chicken farmers exhibited poor knowledge and attitudes on usage of antibiotics and AMR.

The overall prevalence of ESBL producing *E. coli* and *K. pneumoniae* was 20.10% and 10.39%, respectively. Highest prevalence of ESBL producing *E. coli*

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(33.80%) and *K. pneumoniae* (29.63%) was recorded during monsoon season. Antibiogram assay for phenotypic confirmation of all *E. coli* and *K. pneumoniae* recorded resistance to cefpodoxime and ceftriaxone, respectively. ESBL E-test was recorded to be more effective than CDT. Resistance to at least three classes of antibiotics was revealed by 92.73% of the ESBL producing *E. coli* and 88.42% of the ESBL producing *K. pneumoniae*. All the ESBL producing *E. coli* and *K. pneumoniae* carried blaCTX-M, blaTEM and blaSHV genes, which were present either alone or in combination with one another.

# **Comparative Studies on Wastewater Quality Associated with Livestock Farms, Hospitals and Industries in and Around Guwahati City of Assam**

*Koushik Kakoty*

The physicochemical and bacteriological qualities of wastewater appear to be poorly understood in Assam, and research works into the effects of wastewater are insufficient. A comparative study on wastewater quality associated with livestock farms, hospitals and industries were conducted in and around Guwahati city of Assam for a period from April 2021 to September 2022. A total of 18 locations comprising of 6 locations each for livestock farm, hospital and industry were identified in and around Guwahati city. Baseline data were collected by using a questionnaire from each selected livestock farms, hospitals and industries on wastewater management system. Majority of the livestock farm workers (41.67%) and industrial workers (50.00%) belong to the age group of 31-45 years whereas, hospital workers (50.00%) belonged to the age group of 18-30 years. In all the sectors male were predominant. Majority of the livestock farm workers (66.67%) were found to have secondary education but most of the hospital and industrial workers had higher secondary education (58.33%). In livestock farm, a smaller number of sewage treatment plant (16.67%) was recorded and all the sectors neither reuse nor sampled their wastewater. Most of the livestock farm workers were unaware of wastewater management and the use of protective equipment was less in comparison to hospital and industrial workers. The mean physicochemical parameters such as pH, turbidity, total dissolved solid, total suspended solid, total solid, biological oxygen demand and electrical conductivity were higher in livestock farm wastewater than hospital and industrial wastewater. Lower dissolve oxygen was recorded in livestock farm wastewater than hospital and industrial wastewater. Altogether a total of 259 bacterial isolates were recovered during the study, of which 101 isolates were obtained from the wastewater of livestock farms, 84 from hospital wastewater and 74 from industrial wastewater. Overall prevalence rate of *E. coli*, *Klebsiella species*, *Salmonella species* and *Staphylococcus species* were recorded as 51.35%, 16.22%, 20.84% and 11.58%, respectively. *E. coli*, *Klebsiella species* and *Staphylococcus*

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*species* showing highest resistance against Ceftriaxone (65.41%, 54.76% and 63.33%) and *Salmonella* showing more resistance against Cefotaxime (46.29%). The prevalence of antimicrobial resistance gene *bla*TEM (20.00%) is higher in *E. coli*, *bla*CTX-M (28.00%) in *Klebsiella species* and *sul1* (15.00%) in *Salmonella species*. The predominance of *nuc* and *mecA* gene in *Staphylococcus species* were 95.00% and 10.53%, respectively. In the present study the various physico-chemical parameter limits of wastewater collected from livestock farms, hospitals and industries were found higher than that of WHO prescribed limits. Discharging such untreated wastewaters into water bodies is responsible for major source of water pollution leading to outbreaks of diseases and presence of antibiotic resistant bacteria continues to pose a significant public health problem.

## **Molecular Epidemiology of *Mycobacterium tuberculosis* Complex (MTC) and *Mycobacterium avium* subsp. *Paratuberculosis* in Peri-Urban and Urban Dairy Farms of Guwahati**

*Nur Abdul Kader*

Bovine tuberculosis (bTB) and paratuberculosis (JD) are the two most common diseases caused by pathogenic mycobacterial species in livestock. Bovine tuberculosis is a chronic type of neglected zoonotic disease caused by *Mycobacterium bovis* which is distributed worldwide. The present study was carried out from December, 2020 to November, 2021 and envisaged to collect the baseline data from peri-urban and urban dairy farms of Guwahati following questionnaire method and molecular detection of *Mycobacterium tuberculosis* complex (MTC) and *M. avium* subsp. *paratuberculosis* (MAP) using specific primer on the targeted DNA. Farms (36) were identified from 12 different locations and the GPS coordinates of latitudes and longitudes of the selected farms were recorded. A total of 360 animals (10 from each farm) were initially screened by SICCT to determine the prevalence of bTB. PCR was carried out from 620 samples for detection of bTB (milk: 360, nasal swab:150 and tissue samples from slaughtered cattle: 110) and for detection of paratuberculosis, 220 samples (milk:100; intestine: 60 and fecal: 60) were targeted.

Baseline data revealed that 61.11% respondents were of illiterate, 66.67% had no awareness about bovine tuberculosis and 41.67% consumed unprocessed milk and milk products. SICCT depicted 38 cattle to be positive reactors for bTB, yielding the overall prevalence of 10.55%. Age group 5 years and above was found to be more susceptible for bTB (17.18%). PCR of 16 (4.44%) milk samples showed presence of *Mycobacterium* genus specific *hsp65* gene and two milk samples revealed the presence of MTC DNA by amplifying the IS6110 sequence. Presence of *hsp65* gene was detected only in 1 (0.6%) nasal swab whereas, out of 110 tissue samples, 24 (21.81%) were detected as genus *Mycobacterium* by the presence of *hsp65* gene in PCR. IS6110 &

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IS1081 PCR confirmed the presence of MTC DNA in tissue samples 15 (13.36%) and 18 (16.36%), respectively. Speciation of MTC DNA showed 8 (7.27%) and 5 (4.54%) by amplifying 500 bp fragments and RD4 region, respectively. Most of the MTBC positive samples in conventional PCR, were detected as positive by real-time PCR targeting insertion element IS6110 and IS1081 with Ct values ranging from 13.45 to 34 and 12.88 to 33, respectively. In molecular detection of paratuberculosis, 7/60 (11.66 %) intestinal samples and 1/60 (1.66%) fecal samples showed the presence of both *hsp65* and MAP specific IS900 gene and their identities were confirmed by sequencing.

The study highlighted the wide spread prevalence of bovine tuberculosis and paratuberculosis in peri-urban and urban dairy farms and it is of utmost importance to undertake a comprehensive epidemiological study and implementation of one health approaches for strategic control and prevention of bTB and MAP.

## **Surgical Sterilization of Captive Sambar Deer (*Cervus unicolor*)**

*Deepjyoti Deka*

Eighteen clinically healthy captive sambar stags, weighing 80-110kgs were divided into three groups, containing of 6 calves in each group, where group-A received xylazine hydrochloride @ 1.5 mg/kg and ketamine hydrochloride @ 2.5 mg/kg bodyweight intramuscularly, group-B received xylazine hydrochloride @ 1.5 mg/kg and tiletamine-zolazepam @ 2.5mg/kg bodyweight intramuscularly and group-C received xylazine hydrochloride @ 1.5 mg/kg + and azaperone @ 1mg/kg bodyweight intramuscularly.

The induction time and recovery time were  $11.83 \pm 1.07$  and  $36.66 \pm 0.95$  minutes respectively in group-A,  $5.16 \pm 0.30$  and  $59.83 \pm 2.40$  minutes respectively in group-B and  $7.16 \pm 0.30$  and  $45.25 \pm 1.09$  minutes respectively in group-C. Induction and recovery were smooth. Muscle relaxation and analgesia were good. Animals of all group exhibited signs of sedation with lowering of head, occasional bellowing, heavy upper eyelid (drowsiness), onset of salivation, reduced tail movement and signs of staggering. Polyuria was observed at recovery.

Heart rate decreased significantly ( $p < 0.05$ ) in group-A, B and C. Respiration increased significantly ( $p < 0.01$ ) and rectal temperature showed non-significant ( $p > 0.05$ ) difference in all the three groups. Respiratory tidal volume increased non-significantly ( $p > 0.05$ ) and respiratory minute volume showed high significant ( $p < 0.01$ ) decreased in the all the three groups. SpO<sub>2</sub> decreased non-significantly ( $p > 0.05$ ) in the group-A, B but in group-C, SpO<sub>2</sub> increased significantly ( $p < 0.01$ ). Hb, TPC, TEC and TLC also decreased non-significantly ( $p > 0.05$ ) in group-A, B and C. Highly significant ( $p < 0.01$ ) increased of PCV in group-A, B and C. ALP increased significantly ( $p < 0.05$ ) in group-A and C. AST decreases non-significantly ( $p < 0.05$ ) in group- A and C. Glucose increased significantly ( $p < 0.05$ ) in all the three groups. Total protein decreased non-significantly ( $p > 0.05$ ) in group-A and B and decreased significantly ( $p < 0.05$ ) in group-C. Creatinine increased non-significantly ( $p < 0.05$ ) in all these three groups. BUN showed non-significant ( $p > 0.05$ ) increase group-A and significant increase in group-B and C.

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**Department: Veterinary Surgery and Radiology**

**Major Adviser: Dr. Kushal Konar Sarma**



Based on the findings of the study, xylazine - Zoletil® 100 anaesthesia produced a balanced anaesthesia with excellent analgesia and muscle in sambar stags followed by the xylazine-azaperone. Caudectomy has got advantageous over vasectomy in terms of mean time required to perform the surgery. No such behavioral and physical changes were observed among the operated sambar stags over a period of 1 year during the study.

## **Ultrasonographic Evaluation of the Internal Organs in Captive and Wild Animals of Assam**

*Nirmali Sarma*

The present study entitled “Ultrasonographic Evaluation of the Internal Organs in Captive and Wild Animals of Assam” was undertaken to perform a clinical and opportunity-based study on a total of 46 captive and free-ranging wild animals belonging to 19 different species, to observe the ultrasonographic morphology of the various internal organs, record their anatomical location and acoustic windows, collect morphometric data and diagnose pathological alterations, if any, and to preferably establish a baseline set of ultrasonographic-splanchnological data on certain species. The studies were conducted in the Assam State Zoo Division, Zoo Road, Guwahati and the Department of Surgery & Radiology, College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati.

Out of the 46 animals studied, there were 16 mammals, 1 bird and 2 reptiles. The mammals were further grouped as Omnivores, Herbivores and Carnivores based on their dietary characteristics. Herbivores were further divided into Non-ruminants and Ruminants based on the fundamental anatomical differences of their digestive system. Highest number of animals studied belonged to the group of mammals, consisting of Himalayan Black Bear, Western Hoolock Gibbon, Golden Langur, Asiatic Elephant, Rhesus Macaque, Red Serow, Barking Deer, Hog Deer, Eld’s Deer, Asiatic Lion, Bengal Tiger, Indian Leopard, Striped Hyena, Jungle Cat, Asian Palm Civet and Black Panther. Minimum number of animals studied was a single bird, the Lesser Adjutant Stork. The two reptiles examined were both snakes, namely, the Copper-headed Trinket Snake and Indian Rock Python.

All 46 animals were subjected to thorough observations of their clinico-physiological signs, haemato-biochemical parameters and ultrasonographic studies to perform a survey-based study on these wild species. Radiography was performed in 3 animals only. Thereafter, an attempt was made to correlate the findings of clinico-physiological signs, haemato-biochemical alterations and ultrasonographic findings and radiographic observations in some, for evaluation of the internal structures in different captive and free-ranging wild animals of Assam. Animals that were diagnosed with

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specific anomalies requiring surgical or medicinal intervention were treated as per standard procedures.

In this study, a total of 33 animals were from captivity while 13 were from free-ranging conditions, 39 animals were subjected to chemical restraint and 7 were managed by physical restraint, 11 animals were deemed clinically healthy but 35 had pathological alterations detected on clinical examinations. There were 24 males and 22 females from different species of wild animals. Furthermore, highest number of animals belonged to the adult age group (36 animals) whereas 4 animals were adolescents and 3 in each group of juvenile and geriatric animals.

In most animals, the ultrasonographic observations could be correlated to the information obtained from anamnesis, behavioural observations, clinico-physiological records, haemato-biochemical parameters as well as radiography in select cases. However, in a few studies, it was observed that the clinico-physiological and haemato-biochemical findings were inconsistent with the ultrasonographic findings. Radiography provided excellent detail of the skeletal disorders, however, sufficient information pertaining to soft tissues could not be obtained. This could be attributed to the superimposition of soft tissues on a Skiagram.

Ultrasonography aided in the outstanding visualisation of most of the internal organs in almost all species of the captive and free-ranging wild animals taken for study, by application of which the anatomical locations, ultrasonographic morphology, morphometrics and pathological conditions of different internal organs could be recorded. However, certain challenges were also encountered during sonographic studies; obstruction to the passage of ultrasonic waves due to presence of burn lesions, tympanites, ribs and air sacs had caused artefacts leading to lack of visualisation of target organs. Also, sheer large body size of certain animals combined with the mere 16 cm depth of ultrasonic waves caused insufficient visualisation of target organs.

However, ultrasonography effectively aided in the diagnosis of various pathological conditions such as uterine tumour, hepatic fatty changes, hepatic abscesses, ovarian cyst, septate gall bladder and splenic mass. Additionally, this imaging modality aided in detection of a congenital anomaly i.e.; an ectopic left kidney.

## **Effect of Polyherbal Feed Supplementation on Performances of Assam Hill Goat**

*Chinmoy Dutta*

The experiment was conducted for a period of nine months and a digestion trial thereafter to study the effect of feeding a polyherbal feed supplement constituted of Shatavari, Fenugreek and Ajwain mixed in 1:1:1 ratio on different performances of Assam Hill goat. Thirty six healthy weaned kids (eighteen male and eighteen female) of similar age and bodyweight were allocated to three experimental groups, control (C0), treatment-1 (T1) and treatment-2 (T2) with twelve animals in each group (six male and six female). Kids of all the three groups were fed with a standard basal diet consisted of concentrate and green fodder with supplementation of the polyherbal feed supplement @ 1 gm and 2 gm per kg body weight daily in the treatment-1 (T1) and treatment-2 (T2) groups respectively.

The average body weight at 19th fortnight i.e., at 12 months of age were  $13.84 \pm 0.032$ ,  $14.47 \pm 0.021$  and  $16.24 \pm 0.040$  kg control and the two treatment groups (T1 and T2) respectively. The overall body weight (kg) of two treatment groups were significantly higher ( $P < 0.01$ ) than that of control group. In respect of sex, the male animals attained higher bodyweight than that of female animals at all the stages of experiment.

The average fortnightly body weight gain during the experimental were  $0.476 \pm 0.006$ ,  $0.510 \pm 0.005$  and  $0.603 \pm 0.006$  kg for control and the two treatment groups respectively and revealed significant ( $p < 0.01$ ) difference from the fourth fortnight and showing significant differences between the treatment groups, between the fortnights and between both the sexes. The male goats gained more overall body weight i.e.,  $0.556 \pm 0.005$  kg over the female goats i.e.,  $0.503 \pm 0.007$  kg throughout the experiment.

The initial mean values of fortnightly measurement (cm) of body conformation (body length, height at wither, chest girth, neck girth, tail length, length of head, breadth of head, horn length and ear length) of Assam Hill kids in control (C0), treatment-1 (T1) and treatment-2 (T2) groups were similar and non-significant. However, at the end of experiment, significant differences ( $p < 0.01$ ) among control and two treatment groups were observed for body length, height at wither and chest girth. Other measurements,

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neck girth, tail length, length of head, breadth of head, horn length and ear length were apparently higher in the treatment groups. Sex wise, the male goats had better body conformation than female animals.

The overall mean values of respiration rate in Assam Hill goats were  $19.68 \pm 0.473$ ,  $19.56 \pm 0.279$  and  $19.68 \pm 0.229$  breaths/min in control (T0), treatment-1 (T1) and treatment-2 (T2) respectively. The average mean values of pulse rate of Assam hill goat fed with polyherbal supplementation during the studies were  $78.56 \pm 0.750$ ,  $78.50 \pm 1.047$  and  $78.40 \pm 0.786$  beats/min for control and the two treatment groups respectively. The overall mean values of rectal temperature of the goats were  $102.38 \pm 0.161$ ,  $102.4 \pm 0.176$  and  $102.32 \pm 0.170$  °F for control and treatment groups respectively. There were no significant ( $P > 0.01$ ) differences in pulse rate, respiration rate and temperature among the three groups and sex wise between male and female animals.

The average values of BCS of the male goats at puberty were  $2.70 \pm 0.032$ ,  $2.94 \pm 0.054$  and  $3.05 \pm 0.074$  as well as at maturity were  $2.72 \pm 0.028$ ,  $3.01 \pm 0.076$  and  $3.15 \pm 0.059$  in control (C0), treatment-1 (T1) and treatment-2 (T2) respectively. In respect of female goat, the overall mean values of BCS puberty were  $2.66 \pm 0.029$ ,  $2.86 \pm 0.037$  and  $2.91 \pm 0.050$  and at maturity the BCS were  $2.68 \pm 0.029$ ,  $2.9 \pm 0.047$  and  $2.94 \pm 0.056$  for animals in Co, T1 and T2 respectively. The results showed significant ( $P < 0.01$ ) difference in BCS at puberty and maturity both in male and female among the three experimental groups. Again, the BCS were found better at maturity than that of puberty in both male and female goats. The average haemoglobin were  $7.36 \pm 0.05$ ,  $7.44 \pm 0.057$  and  $7.52 \pm 0.051$  g/dl in control and two treatment groups respectively as well as  $7.56 \pm 0.053$  and  $7.37 \pm 0.052$  g/dl in male and female respectively. All the values were within the normal ranges and showed no significance differences ( $P > 0.01$ ) among the treatment groups and the sexes. The average blood glucose concentration in different groups during different quaternary varied from  $69.94 \pm 0.864$  to  $73.73 \pm 0.430$ ,  $69.86 \pm 0.884$  to  $74.67 \pm 0.667$  and  $69.38 \pm 0.824$  to  $74.63 \pm 0.597$  mg/dl with overall values as  $71.78 \pm 0.623$ ,  $72.27 \pm 0.926$  and  $72.01 \pm 0.649$  mg/dl in control, treatment-1 (T1) and treatment-2 (T2) groups respectively. Results showed no significant difference ( $P > 0.01$ ) between control and treatment groups. The mean total plasma protein was found to be  $7.37 \pm 0.049$ ,  $7.46 \pm 0.052$  and  $7.52 \pm 0.038$  gm/dl of blood for control, treatment-1 (T1) and treatment-2 (T2) groups, respectively. Sex wise, the overall mean total blood plasma protein for male and female were  $7.51 \pm 0.062$  and  $7.39 \pm 0.047$  gm/dl found no significant differences ( $P > 0.01$ ) among the treatment groups and sexes on overall as well as at any stage of the experiment till the end. However, the respective values improved within the normal range.

The average growth hormone (ng/ml) levels of the experimental goats were  $2.94 \pm 0.097$ ,  $3.02 \pm 0.010$  and  $3.07 \pm 0.012$  in control, treatment-1 (T1) and treatment-2 (T2) groups respectively. Similarly, the overall mean growth hormone (ng/ml) concentration in male and female were  $2.99 \pm 0.068$  and  $2.97 \pm 0.011$  ng/ml. The level of growth hormone (ng/ml) increased among the treatment groups and the sexes numerically but

was not significant statistically. The mean estrogen level (pg/ml) at 1st estrous were found to be  $14.235 \pm 0.015$ ,  $15.288 \pm 0.018$  and  $15.548 \pm 0.012$  for control, treatment-1 (T1) and treatment-2 (T2) groups respectively. Similarly at 5th estrous when the goats attained 60% to 70% of their adult body weight, the mean estrogen level (pg/ml) were found to be  $22.667 \pm 0.012$ ,  $22.867 \pm 0.016$  and  $23.242 \pm 0.013$  for control and two treatment groups respectively. Results revealed significant differences ( $P < 0.01$ ) among the treatment groups during each estrous till 5th estrous. The mean blood testosterone hormone level (ng/ml) at 11th month were found to be  $2.710 \pm 0.176$ ,  $3.008 \pm 0.136$  and  $3.107 \pm 0.179$  and at 12th month  $2.777 \pm 0.175$ ,  $3.222 \pm 0.108$  and  $3.425 \pm 0.187$  for control and treatment groups respectively. The testosterone level was significantly higher ( $P < 0.01$ ) in among the treatment-1 (T1) and treatment-2 (T2) groups.

The mean average age (days) at first heat were  $199.833 \pm 3.842$ ,  $183.333 \pm 2.985$  and  $183.167 \pm 4.110$  for Assam Hill goats in control, treatment-1 (T1) and treatment-2 (T2) groups respectively. The corresponding age at fifth heat were  $283.845 \pm 3.842$ ,  $267.287 \pm 2.982$  and  $267.062 \pm 4.179$  respectively. The duration (hr) of first heat were  $26.087 \pm 0.582$ ,  $28.562 \pm 0.970$  and  $28.627 \pm 1.219$  as well as for fifth heat duration (hr) were  $26.955 \pm 0.436$ ,  $32.317 \pm 1.318$  and  $34.197 \pm 1.010$  for goats in control and the two treatment groups respectively. The age at first heat were significantly earlier ( $P < 0.01$ ) in treatment groups compared to control group. The duration of heat revealed marked variations and was significantly high ( $P > 0.01$ ) in fifth heat.

Routine examination of semen samples revealed the mean values of volume, colour, mass activity, individual motility, normal sperm, live sperm and dead sperm (%) at 11th month and 12th month which showed significant differences ( $P < 0.01$ ) among the control and the two treatment groups. The semen volume ( $0.627 \pm 0.008$  ml) and percentage of live sperm ( $85.355 \pm 0.895\%$ ) were highest in T2 group at 12th month of age. The overall semen qualities were found better in treatment groups. The buck of the treatment groups could had been used for mating or even for collection of semen from 11th month onwards instead of 12th months as level of testosterone hormone (ng/ml) and over all semen quality were well within the optimum range and body condition score was found suitable. The average digestibility of the different organic nutrients in Co, T1 and T2, respectively were as : DM (%),  $59.526 \pm 0.051$ ,  $61.069 \pm 0.058$  and  $61.512 \pm 0.058$ ; CP (%),  $72.027 \pm 0.044$ ,  $74.451 \pm 0.032$  and  $75.015 \pm 0.042$ ; EE (%),  $67.727 \pm 0.012$ ,  $68.155 \pm 0.020$  and  $68.364 \pm 0.033$ ; CF (%),  $54.348 \pm 0.054$ ,  $58.474 \pm 0.033$  and  $59.201 \pm 0.017$ ; NFE (%),  $67.026 \pm 0.039$ ,  $67.507 \pm 0.021$  and  $67.785 \pm 0.035$ ; OM (%),  $64.793 \pm 0.041$ ,  $65.977 \pm 0.050$  and  $66.416 \pm 0.051$ . Digestibility remained higher in both the treatment groups than control and improved significantly ( $P < 0.01$ ).

The average cost of concentrate mixture alone and with addition of the polyherbal supplement @ 1gm and 2gm per kg body weight were (Rs.) 1056.13 in control group, 1532.84 in the T1 and 2168.64 in the T2 group. The higher feed costs in treatment groups were found due to the higher price of the polyherbal supplement

costing Rs. 170/Kg. However, the mean body weight gain (kg) was 9.38, 9.63 and 10.54 in Co, T1 and T2, respectively. The findings of the experiment, though cost of feeding is slightly higher in the supplemented groups, those goats indicated better growth and reproduction performances was expected to perform superior yielding higher lifetime return.

# **Effect of Wet and Boiled Diets Feeding on Growth and Carcass Characteristics in Crossbred Hampshire Pigs**

*Lakshya Jyoti Kakati*

Under the supervision of the Department of Livestock Production and Management, College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati-22, the study was conducted at field level in a private farm named “Ruhini Deka Pig Farm” situated at Duwoni village under Manipur gram panchayat of Morigaon district. The laboratory work was performed at the AICRP on Post Harvest Engineering Technology, Department of Livestock Products Technology and the Department of Animal Nutrition, College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati-22 during the period from August 2021 to January 2022.

A total of 36 (thirty six) weaned Hampshire crossbred pigs were selected randomly from the littermates of 6-8 piglets maintained at the “Ruhini Deka Pig Farm” complex. The pigs (56 days old) were randomly divided into three treatment groups depending upon nearness of body weight in such a manner that each group consisted of twelve piglets with equal number of males and females. The animals were allotted to 3 experimental groups *viz.*, control (reared on standard conventional feed), T<sub>1</sub> (reared on standard conventional wet feed @ the ratio of 1:1.5) and T<sub>2</sub> (reared on standard conventional boiled /cooked feed). Weaned piglets were housed individually under conventional housing system up to the market age (32 weeks). The space allowance per pig was provided 10 x 9 ft. (approx.). The standard conventional feed both grower and finisher feed were prepared as per ICAR (2013) recommendation. Feed was offered in the morning and evening. Clean and wholesome water was provided round the clock throughout the experiment. At the end of the experiment, 3 animals per treatment (the lightest, heaviest and the middle by weight) were selected for slaughter by humane method.

Boiled diet could significantly ( $p < 0.05$ ) influence body weight, total and average daily feed intake of crossbred Hampshire pigs. However, average daily gain was not found to be significant during the experimental period yet the findings clearly shows

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numerical superiority in regards to body weight, average daily gain, total and average daily feed intake. FCE was found to be the best in boiled fed ( $T_2$ ) group showing better efficiency over control and wet fed ( $T_1$ ) group.

Moisture ( $P < 0.01$ ) was affected by soaking and boiling of feed, while crude protein, crude fibre, ether extract, total ash and showed no significant difference. Boiling of feed (grower-finisher) showed significant change ( $p < 0.01$ ) in the phosphorus content of the experimental ration.

The pre-slaughter weight, hot carcass weight and dressing percentage, carcass measures *viz.*, Carcass length, backfat thickness and loin eye area was not affected. Wholesale cuts (ham, bacon, loin, boston butt and picnic) did not show any significant difference ( $p > 0.05$ ) among the groups. Likewise there was no significant difference ( $p > 0.05$ ) in regards to weight of the edible and inedible offals among the treatment groups. In relation to physico-chemical properties, water holding capacity and ultimate pH at 6 hours of *L. dorsi* showed no significant ( $P > 0.05$ ) difference among the groups.

On sensory evaluation of pork, flavour and juiciness revealed significant difference among the groups while colour, texture and overall acceptability of pork showed no difference among the experimental groups. However, the present findings showed numerical superiority among the groups in regards to sensory parameters.

The cost feeding per kg weight gain was found to better at the end of the feeding trial slightly in the boiled fed ( $T_2$ ) group followed by we fed ( $T_1$ ) and control group.

Therefore, it may be concluded that feeding of boiled feed may be suggested for improved productive performance, feed conversion efficiency, superior carcass and pork quality characteristics and better cost of production.

## **Performance of Crossbred Hampshire Pig Fed on Poultry By-Products**

*Nanda Kumar Roy*

An experiment was conducted to study the effects of the inclusion of poultry by-product meal in the ration of pig replacing the fish meal at different levels viz. 50% and 100% on the growth performance, feed conversion efficiency, haemato-biochemical profile, carcass characteristics and meat quality, and cost of feeding in Crossbred Hampshire pigs.

A total of Eighteen (18) weaned Crossbred Hampshire pigs (9 castrated male and 9 female) with an average age of 8 weeks and average body weight of  $11.11 \pm 0.02$  kg were selected from an institutional pig farm (30-Sow Teaching Unit) under the Department of Livestock Production and Management, College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati-22. The trial was conducted for 150 days, from 15th October 2021 to 14th March 2022. The piglets were divided into three treatment groups depending upon the nearness of body weight and age in such a manner that each treatment will consist of six pigs (3 male and 3 female in each group) viz. groups C, T1, and T2. The animals under T1 group were provided with Standard conventional feed with 2.5% inclusion of poultry by-product meal replacing 50% of fish meal. However, the animals of T2 group were provided with Standard conventional feed with 5% inclusion of poultry by-product meal replacing 100% fish meal. The control group was provided with standard conventional feed without the inclusion of poultry by-products. The experimental rations were prepared as per BIS-2005.

The average initial body weights (kg) of weaned piglets of all experimental groups were not significant ( $P \geq 0.01$ ) different among the groups which ranged from  $11.08 \pm 0.28$  kg to  $11.13 \pm 0.11$  kg. The average final body weights (kg) of pigs in different groups in the finisher stage were  $69.86 \pm 0.63$ ,  $71.02 \pm 0.49$ , and  $72.08 \pm 0.38$  for C, T1, and T2 groups respectively at the end of the 10th fortnight of the experimental period. The overall average daily gains (kg) during the experimental period were  $0.390 \pm 0.01$ ,  $0.398 \pm 0.01$ , and  $0.405 \pm 0.01$  for C, T1, and T2 groups respectively. The overall body weight gains (kg) during the experimental period were  $58.73 \pm 0.62$ ,  $59.90 \pm 0.45$ , and  $60.99 \pm 0.4$  for C, T1, and T2 groups respectively. Statistical analysis

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revealed that there were non-significant differences in the final body weight (kg), ADG (kg) and overall body weight gain (kg) of pigs in different treatments and control groups during the experiment. The overall Average daily feed intake (DM basis) during the experimental period was  $1.392 \pm 0.01$  kg,  $1.382 \pm 0.01$  kg, and  $1.353 \pm 0.01$  kg for C, T1, and T2 groups respectively. The overall average feed intakes (fresh basis) during the experimental period were  $232.044 \pm 1.38$  kg,  $230.351 \pm 2.23$  kg, and  $225.523 \pm 2.64$  kg for C, T1, and T2 groups respectively. Statistical analysis revealed non-significant differences in the overall daily feed intake and total feed intake (DM basis) of pigs among the different treatment and control groups under the experiment. The overall Average feed conversion efficiency (fresh basis) during the experimental period was  $3.92 \pm 0.21$ ,  $3.78 \pm 0.18$ , and  $3.66 \pm 0.13$  for C, T1, and T2 groups respectively where non-significant differences existed between different treatment and control groups under the experiment.

The average daily changes in body length in the C, T1 and T2 groups were  $0.37 \pm 0.02$ ,  $0.37 \pm 0.01$ , and  $0.38 \pm 0.03$  respectively. The average daily changes in height at withers in the C, T1, and T2 groups were  $0.27 \pm 0.00$ ,  $0.27 \pm 0.00$ , and  $0.28 \pm 0.00$  respectively. The average daily changes in Heart girth in the C, T1 and T2 groups were  $0.37 \pm 0.01$ ,  $0.37 \pm 0.01$ , and  $0.38 \pm 0.02$  respectively. Analysis of variance revealed that there is no significant differences existed between the different treatment and control groups. Higher body length, height at withers, and Heart girth were observed in the T2 group followed by T1 and C groups. The coefficient of correlation of linear body measurements with the body weight of crossbred Hampshire pigs was found to be positively correlated.

Non-significant differences in Hb, WBC, RBC, and HCT levels were recorded during different periods between different treatment and control groups that indicate the poultry by-product inclusion did not influence the hematological profile in Crossbred Hampshire pigs. In the Blood biochemical parameters, the concentration of Serum globulin, glucose, total cholesterol, triglyceride, Ca, and P levels were found within the normal physiological range in all experimental groups. There was a significant difference in respect of serum total protein and albumin at the mod of the experiment.

The Live weight (kg), Slaughter weight (kg), Hot Carcass weight (kg), chilled Carcass weight (kg), Hot dressing percentage (%), chilled dressing percentage (%), Carcass length (cm), Back fat thickness (cm), and Loin eye area (cm<sup>2</sup>) showed non-significant difference among different groups. Wholesale cuts (ham, bacon, loin, picnic, Boston butt, and jowl) showed non-significant differences among the groups. The edible and inedible offal also did not differ significantly ( $P > 0.01$ ). The proximate composition of *L. dorsi* muscle revealed non-significant differences in moisture, CP, EE, and total ash content among the groups. In relation to Physico-chemical properties, WHC (cm<sup>2</sup>) and pH values of *L. dorsi* muscle of crossbred Hampshire pigs revealed non-significant ( $P > 0.05$ ) differences among the different treatment and control groups. On the sensory evaluation of pork, colour, flavor, juiciness, texture, and overall acceptability of pork

showed no difference among the experimental groups. Texture profile and colour profile also revealed no significant difference between different treatments and Control group.

During the grower stage, feed cost (Rs.) per kg gain was 96.29 for the C group, 93.59 for T1, and 87.92 for the T2 group, while during the finisher stage the feed cost (Rs.) per kg gain was 138.17, 132.80 and 129.29 in for C, T1 and T2 respectively. The highest profit (in terms of feed cost/kg gain) was observed in the T2 group followed by T1 and in comparison to the Control group. Thus it can be concluded that the inclusion of poultry by-products up to 5% level in the pig ration replacing fish meal may be recommended in terms of growth and economic production without any adverse effect on general performance.

**Keywords:** Poultry by-product meal, pigs, growth performance, carcass traits, and meat quality.

## **Effects of Housing Management on Dairy Cow Productivity**

*Raj Jyoti Deka*

The experiment was carried out from January to December, 2021 on different types of housing systems adopted for dairy farming viz. i) Institutional Housing (IH) adopted at institutional level following all the scientific approaches at Instructional Livestock Farm (Cattle) under the Department of Livestock Production and Management, College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati-22 and ii) Traditional Housing (TH) adopted by progressive dairy farmers of Amerigog area in Kamrup (M) District of Assam. The experiment was carried out with a total of 36 (Thirty Six) lactating dairy animals (crossbred cows) keeping 18 numbers of animals each under IH (Institutional Housing) and TH (Traditional Housing) management systems. Furthermore, each group was sub-divided into three groups viz. T0, T1 and T2 with 6 (Six) animals in each treatment group. The 6 (Six) animals per group was selected on the basis of apparently similar in parity, physiological status and preceding lactation yield.

Two different treatments were applied in two different IH and TH management system with one group as control in each housing management system i.e. IH and TH. The T0 was considered as the control without treatment and was managed under existing (regular) management system. The T1 was supplemented with dry yeast powder (*Saccharomyces cerevisiae*) with the recommended dose @3.0 gm per cow as probiotics over regular management system and the T2 was supplemented with dry yeast powder (*Saccharomyces cerevisiae*) with the recommended dose @3.0 gm per cow as probiotics over regular management system and modification of the micro climate for more air circulation by fixing dairy fan (side fan). The highest maximum temperature ( $33.83 \pm 0.28$  °C) was recorded in the month of August and the lowest minimum temperature ( $12.66 \pm 0.37$  °C) was recorded in the month of January during the year in both G1 & G2.

The mean monthly lowest outdoor temperature (O Temp.) was recorded as  $18.10 \pm 0.22$  °C and  $18.16 \pm 0.22$  °C in the morning and  $22.06 \pm 0.38$  °C and  $22.14 \pm 0.38$  °C in the afternoon during the month of January in G1 and G2 respectively. The highest

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outdoor temperatures were  $31.17 \pm 0.43$  °C and  $31.28 \pm 0.43$  °C in the morning and  $32.38 \pm 0.62$  °C and  $32.33 \pm 0.59$  °C in the afternoon during the month of September in the G1 and G2 respectively.

The mean monthly highest wind speed (Km/hr.) were  $3.07 \pm 0.62$  both in G1 and G2 in the month of April and  $2.58 \pm 0.68$  and  $2.47 \pm 0.69$  in G1 and G2 in the month of March in morning and afternoon respectively. The lowest mean wind speed (Km/hr.) were  $0.21 \pm 0.21$  both in G1 and G2 in the month of February and  $0.13 \pm 0.09$  and  $0.17 \pm 0.07$  in G1 and G2 in morning and afternoon respectively. The lowest mean monthly wet bulb temperatures (WB Temp.) in the morning were  $15.17 \pm 0.21$  and  $15.23 \pm 0.23$  °C in the month of January both in G1 and G2 respectively. However highest mean monthly morning WB Temp. were recorded as  $26.89 \pm 0.16$  °C in the month of August in G1 and  $26.75 \pm 0.23$  °C in the month of September in G2. The mean relative humidity (RH) in percentage were  $87.26 \pm 1.00$  as highest in the month of January and  $69.63 \pm 1.78$  as lowest in the month of April in G1 and  $88.90 \pm 0.93$  as highest in the month of January and  $63.27 \pm 0.82$  as lowest in the month of November in the morning in G2. The analysis of variance (ANOVA) revealed that there is highly significant ( $P < 0.01$ ) difference in DB Temp., RH and THI among the two different housing management viz. institutional housing (G1) and traditional housing (G2). Whereas, there were no significant differences in O Temp., WB Temp. and WS among G1 and G2. But there were highly significant ( $P < 0.01$ ) differences between the months in O Temp., WB Temp., WS, DB Temp., RH and THI.

The overall mean body surface temperature (ST) comprising of all the four seasons were  $36.44 \pm 0.06$  &  $36.44 \pm 0.06$  °C in T0,  $36.41 \pm 0.10$  &  $36.41 \pm 0.10$  °C in T1 and  $36.32 \pm 0.08$  &  $36.32 \pm 0.08$  °C in T2 in the morning and afternoon respectively in G1. The overall mean rectal temperature (RT) comprising of all the four seasons were  $38.18 \pm 0.14$  &  $38.18 \pm 0.14$  °C in T0,  $37.96 \pm 0.27$  &  $37.96 \pm 0.27$  °C in T1 and  $37.72 \pm 0.18$  &  $37.72 \pm 0.18$  °C in T2 in the morning and afternoon respectively in G1. Whereas, the ST were recorded as  $38.29 \pm 0.13$  &  $38.51 \pm 0.10$  in T0,  $38.09 \pm 0.21$  &  $38.32 \pm 0.15$  in T1 and  $37.85 \pm 0.23$  &  $37.94 \pm 0.24$  in T2 in the morning and afternoon respectively in the G2. The overall mean respiration rate (RR) comprising of all the four seasons were  $23.97 \pm 0.26$  &  $23.97 \pm 0.26$  1/min in T0,  $23.80 \pm 0.21$  &  $23.80 \pm 0.21$  1/min in T1 and  $23.64 \pm 0.15$  &  $23.64 \pm 0.15$  1/min in T2 in the morning and afternoon respectively in G1. Whereas the RR were recorded as  $25.13 \pm 0.34$  &  $25.67 \pm 0.61$  in T0,  $24.52 \pm 0.30$  &  $24.65 \pm 0.34$  in T1 and  $23.99 \pm 0.18$  &  $24.20 \pm 0.20$  in T2 in the morning and afternoon respectively in the G2. The overall mean pulse rate (PR) comprising of all the four seasons were  $57.42 \pm 0.22$  &  $57.42 \pm 0.22$  1/min in T0,  $57.08 \pm 0.21$  &  $57.08 \pm 0.21$  1/min in T1 and  $56.97 \pm 0.13$  &  $56.97 \pm 0.13$  1/min in T2 in the morning and afternoon respectively in G1. Whereas the PR were recorded as  $57.99 \pm 0.24$  &  $58.16 \pm 0.25$  in T0,  $57.64 \pm 0.24$  &  $57.85 \pm 0.31$  in T1 and  $57.39 \pm 0.22$  &  $57.64 \pm 0.21$  in T2 in the morning and afternoon respectively in te G2.

The analysis of variance (ANOVA) revealed that there are significant differences ( $P < 0.01$ ) between the G1 and G2 in respect of surface temperature, rectal

temperature, respiration rate and pulse rate. There were non-significant differences ( $P>0.05$ ) between morning and afternoon in respect of ST, RT, RR and PR. However, there were highly significant differences ( $P<0.01$ ) were recorded between the seasons in respect to ST, RT, RR and PR. Highest ST were observed in S1 ( $36.57\pm 0.04$  OC) followed by S3, S2 and S1. The total leukocyte count (TLC) were recorded in percentage (%) as  $22.57\pm 1.67$ ,  $18.30\pm 1.51$  and  $15.75\pm 1.38$ ,  $15.13\pm 0.87$ ,  $13.55\pm 1.40$  and  $12.79\pm 0.89$ ,  $23.66\pm 0.96$ ,  $21.46\pm 0.94$  and  $15.44\pm 1.42$ ,  $24.02\pm 1.42$ ,  $25.76\pm 3.10$  and  $17.47\pm 0.80$  in treatment groups T0, T1 and T2 and during the seasons viz. S1, S2, S3 and S4 respectively in institutional housing (IH). Whereas, the TLC were  $19.73\pm 3.19$ ,  $19.35\pm 3.12$  and  $18.36$ ;  $18.14\pm 3.11$ ,  $15.00\pm 1.68$  and  $13.93\pm 2.87$ ;  $21.61\pm 3.53$ ,  $18.36\pm 2.29$  and  $20.08\pm 2.00$ ;  $24.81\pm 3.44$ ,  $20.13\pm 2.52$  and  $19.90\pm 1.29$  in treatment groups T0, T1 and T2 and during the seasons viz. S1, S2, S3 and S4 respectively in traditional housing (TH). The analysis of variance revealed that there are non-significant differences in TLC and DLC irrespective of housing management i.e. IH and TH. However, highly significant differences ( $P<0.01$ ) were observed in TLC, neutrophil count, lymphocyte count and monocyte count among the seasons irrespective of IH and TH. But no significant differences were recorded among the treatment group.

The overall mean RBC in percentage in T0, T1 and T2 were  $5.51\pm 0.38$ ,  $6.06\pm 0.36$  and  $5.94\pm 0.43$  in IH and  $5.06\pm 0.26$ ,  $4.89\pm 0.27$  and  $4.98\pm 0.29$  in TH. The overall mean PCV in percentage in T0, T1 and T2 were  $24.72\pm 1.39$ ,  $26.63\pm 1.41$  and  $27.16\pm 1.45$  in IH and  $24.85\pm 1.65$ ,  $24.49\pm 1.53$  and  $24.50\pm 1.56$  in TH. The overall mean Hb in percentage in T0, T1 and T2 were  $9.55\pm 0.36$ ,  $10.19\pm 0.42$  and  $10.23\pm 0.42$  in IH and  $9.98\pm 0.57$ ,  $9.57\pm 0.44$  and  $9.71\pm 0.39$  in TH.

The analysis of variance (ANOVA) revealed that there are significant differences ( $P<0.01$ ) between IH and TH in regards to RBC and PCV, whereas no significant difference was observed between IH and TH in terms of Hb content of blood. But, highly significant ( $P<0.01$ ) differences were observed between the seasons in RBC, PCV as well as Hb concentration. Moreover, non significant differences were also observed among the treatment groups in terms of RBC, PCV and Hb content of blood. The overall mean cortisol level (nmol/L) in T0, T1 and T2 were  $34.60\pm 5.73$ ,  $28.56\pm 6.58$  and  $21.11\pm 3.32$  in IH and  $31.74\pm 4.28$ ,  $27.60\pm 6.12$  and  $21.90\pm 2.67$  in TH. The overall mean T3 level (nmol/L) in T0, T1 and T2 were  $1.51\pm 0.07$ ,  $1.41\pm 0.07$  and  $1.29\pm 0.05$  in IH and  $1.49\pm 0.11$ ,  $1.43\pm 0.09$  and  $1.29\pm 0.05$  in TH. The overall mean T4 level (nmol/L) in T0, T1 and T2 were  $42.69\pm 7.92$ ,  $37.20\pm 7.57$  and  $34.88\pm 6.99$  in IH and  $45.48\pm 7.26$ ,  $38.77\pm 6.94$  and  $34.47\pm 5.79$  in TH.

The analysis of variance revealed that there were non-significant ( $P>0.05$ ) between the IH (G1) and TH (G2) in terms of the hormonal parameters viz. Cortisol, T3 and T4. But highly significant ( $P<0.01$ ) differences have been observed among the seasons in terms of Cortisol and T4. The level of T3 is not significant ( $P>0.05$ ) between interaction of the seasons. Moreover, highly significant ( $P<0.01$ ) levels of Cortisol and T3 were recorded among the treatment groups viz. T0, T1 and T2, where, T4 level was significant ( $P<0.05$ ) among the treatment groups. The mean daily milk yield (Lt.) were

recorded as  $6.66 \pm 0.97$ ,  $6.61 \pm 0.77$  and  $8.84 \pm 1.13$  in IH (G1) and  $8.99 \pm 1.08$ ,  $9.08 \pm 1.00$  and  $9.98 \pm 0.66$  in TH (G2) in the treatment groups viz. T1, T2, T3 respectively.

The analysis of variance indicated that there were highly significant ( $P < 0.01$ ) differences in average daily milk yield between G1 (IH) and G2 (TH), where, average daily milk yield highest ( $9.35 \pm 0.29$ ) in G2 (TH). Highly significant differences ( $P < 0.01$ ) were also observed among the treatment group viz. T0, T1 and T2. Highest ( $9.40 \pm 0.36$ ) mean daily milk was observed in T2. The mean daily milk per month were also highly significant ( $P < 0.01$ ).

The mean fat percentage (%) in the collected milk samples were recorded as  $4.62 \pm 0.15$ ,  $4.92 \pm 0.03$  and  $5.02 \pm 0.07$  in IH and  $4.58 \pm 0.14$ ,  $4.96 \pm 0.06$  and  $5.11 \pm 0.12$  in TH in the treatment groups viz. T0, T1 and T2 respectively. The mean solids not fat (SNF) percentage (%) were recorded as  $8.73 \pm 0.03$ ,  $8.80 \pm 0.04$  and  $8.81 \pm 0.03$  in IH and  $8.77 \pm 0.03$ ,  $8.83 \pm 0.03$  and  $8.84 \pm 0.02$  in TH in the treatment groups i.e. T0, T1 and T2 respectively. The mean total solids (TS) percentage (%) were recorded as  $13.34 \pm 0.19$ ,  $13.49 \pm 0.17$  and  $13.46 \pm 0.18$  in IH and  $13.32 \pm 0.20$ ,  $13.53 \pm 0.17$  and  $13.48 \pm 0.18$  in TH in the treatment groups i.e. T0, T1 and T2 respectively.

The mean protein percentage (%) in the collected milk samples were recorded as  $3.44 \pm 0.02$ ,  $3.48 \pm 0.02$  and  $3.69 \pm 0.16$  in IH and  $3.47 \pm 0.02$ ,  $3.50 \pm 0.01$  and  $3.75 \pm 0.18$  in TH in the treatment groups viz. T0, T1 and T2 respectively. The mean lactose percentage (%) in the collected milk samples were recorded as  $4.45 \pm 0.01$ ,  $4.44 \pm 0.00$  and  $4.45 \pm 0.02$  in IH and  $4.46 \pm 0.02$ ,  $4.45 \pm 0.01$  and  $4.49 \pm 0.03$  in TH in the treatment groups viz. T0, T1 and T2 respectively. The mean ash percentage (%) in the collected milk samples were recorded as  $0.78 \pm 0.00$ ,  $0.79 \pm 0.00$  and  $0.79 \pm 0.00$  in IH and  $0.78 \pm 0.00$ ,  $0.79 \pm 0.00$  and  $0.79 \pm 0.00$  in TH in the treatment groups viz. T0, T1 and T2 respectively. The mean laying and standing time (hrs.) were  $16.78 \pm 0.10$  and  $3.24 \pm 0.09$ ,  $16.91 \pm 0.09$  and  $3.09 \pm 0.09$  and  $17.19 \pm 0.08$  and  $2.81 \pm 0.08$  in T0, T1 and T2 respectively in IH during the S1;  $16.70 \pm 0.12$  and  $3.33 \pm 0.10$ ,  $16.83 \pm 0.09$  and  $3.17 \pm 0.09$  and  $17.12 \pm 0.09$  and  $3.02 \pm 0.15$  in T0, T1 and T2 respectively in IH during the S2;  $15.95 \pm 0.23$  and  $4.05 \pm 0.23$ ,  $16.05 \pm 0.18$  and  $3.95 \pm 0.18$  and  $16.71 \pm 0.14$  and  $3.42 \pm 0.25$  in T0, T1 and T2 respectively in IH during the S3 and  $16.13 \pm 0.18$  and  $4.37 \pm 0.49$ ,  $16.20 \pm 0.19$  and  $3.80 \pm 0.19$  and  $16.63 \pm 0.17$  and  $3.37 \pm 0.17$  in T0, T1 and T2 respectively in IH during the S4. Furthermore, the mean laying and standing time (hrs.) in TH were  $16.82 \pm 0.11$  and  $3.17 \pm 0.07$ ,  $17.00 \pm 0.12$  and  $3.00 \pm 0.12$  and  $17.28 \pm 0.11$  and  $2.72 \pm 0.11$  in T0, T1 and T2 respectively during the S1;  $16.64 \pm 0.13$  and  $3.39 \pm 0.11$ ,  $16.67 \pm 0.16$  and  $3.33 \pm 0.16$  and  $17.04 \pm 0.10$  and  $3.09 \pm 0.14$  in T0, T1 and T2 respectively during the S2;  $16.05 \pm 0.22$  and  $3.95 \pm 0.22$ ,  $16.05 \pm 0.18$  and  $3.95 \pm 0.18$  and  $16.73 \pm 0.14$  and  $3.41 \pm 0.25$  in T0, T1 and T2 respectively during the S3 and  $16.24 \pm 0.13$  and  $3.76 \pm 0.13$ ,  $16.26 \pm 0.15$  and  $3.74 \pm 0.15$  and  $16.70 \pm 0.13$  and  $3.44 \pm 0.23$  in T0, T1 and T2 respectively during the S4.

The mean Barn Used Pattern (BUP) in terms of Cow Comfort Index (CCI) and Stall Standing Index (SSI) have been recorded as  $81.95$  &  $18.74$  and  $82.19$  &  $17.84$  in



T0; 82.49 & 17.51 and 82.48 & 17.53 in T1 and 84.56 & 15.78 and 84.69 & 15.83 in T2 in two different housing system i.e. IH (G1) and TH (G2) respectively.

The analysis of variance revealed that there were no significant ( $P>0.05$ ) differences in the barn used pattern of cows between the housing system, seasons and treatment groups viz. T0, T1 and T2. But there were highly significant differences ( $P<0.01$ ) in CCI and SSI (laying and standing position).

# **Amelioration of Heat Stress Through Certain Managemental Interventions in Lactating Dairy Cows**

*Venus Das*

The present experiment was executed in the Instructional Livestock Farm (Cattle) and Sahiwal Cattle Farm under in the Livestock Farm Complex, College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati-22 to observe the heat stress amelioration capacity of body cooling and bypass fat feeding during summer season (1st May to 31st August, 2022) in lactating dairy cows.

A total of twenty four (12 Holstein-Friesian crossbred and 12 pure Sahiwal) lactating cows were divided into three groups with eight animals in each group with similar parity, stage of lactation and average daily milk production and with equal number of each breeds. The experimental animals were offered feed twice daily individually @ 4 percent of body weight on DM basis to meet up the optimum nutritional demand (NRC, 2001). Out of total DM 1/3rd was given standard concentrate feed (CP: 18% & TDN: 68.00%) prepared in the farm and 2/3rd was given roughages. Out of total roughage 1/3rd was given as paddy straw and 2/3 mixed green fodders such as Para (*Brachiaria mutica*), Napier (*Pennisetum purpureum*) and Guinea (*Panicum maximum*) grasses in equal parts. In the treatment group bypass fat was fed along with concentrate mixture @ 100 g in the morning and 100 g in the afternoon daily. The experiment was followed by a 7 days of digestibility trial.

The average daily milk yield for T1, T2 and T3 group was 5.94±0.09, 8.26±0.12 and 9.58±0.20 kg, respectively and for Holstein-Friesian crossbred and Sahiwal cow, it was 8.57±0.23 and 7.37±0.13 kg, respectively. The average daily milk yield was significantly ( $p<0.01$ ) higher in T2 and T3 group than the T1 group. The average fat, protein, SNF, lactose, ash, specific gravity and freezing point depression of milk in T1, T2 and T3 group was 3.07±0.11, 3.62±0.13 and 4.31±0.20; 3.46±0.02, 3.53±0.02 and 3.59±0.02; 9.26±0.04, 9.34±0.04 and 9.34±0.04; 5.38±0.03, 5.41±0.03 and 5.48±0.02; 0.75±0.01, 0.78±0.01 and 0.79±0.00; 1.0348±0.0001, 1.0349±0.0002 and 1.0352±0.00 and - 0.63, - 0.64 and - 0.63 percent, respectively and for Holstein-Friesian crossbred

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**Abstract of Ph.D. thesis**

**Department: Livestock Production and Management**

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and Sahiwal cow, it was  $3.74 \pm 0.11$  and  $3.58 \pm 0.14$ ;  $3.53 \pm 0.02$  and  $3.53 \pm 0.0$ ;  $8.06 \pm 0.19$  and  $9.3 \pm 0.03$ ;  $5.42 \pm 0.02$  and  $5.42 \pm 0.02$ ;  $0.77 \pm 0.00$  and  $0.76 \pm 0.00$ ;  $1.0348 \pm 0.001$  and  $1.0351 \pm 0.0001$  and - 0.63 and - 0.64 percent, respectively. The analysis of variance showed that there was highly significant ( $p < 0.01$ ) effect of treatment on the average fat, protein, ash and non-significant ( $p > 0.05$ ) effect on SNF, lactose, specific gravity and freezing point depression. The average fat, protein and ash content (%) was significantly ( $p < 0.01$ ) increased in T2 and T3 groups.

The average daily dry matter intake (DMI), dry matter intake per 100 kg body weight and feed conversion efficiency (FCE) for T1, T2 and T3 groups was  $11.93 \pm 0.21$ ,  $14.66 \pm 0.19$  and  $15.42 \pm 0.22$  kg;  $2.43 \pm 0.03$ ,  $2.98 \pm 0.02$  and  $3.10 \pm 0.03$  percent and  $0.50 \pm 0.01$ ,  $0.51 \pm 0.01$  and  $0.51 \pm 0.01$ , respectively. The average daily DMI, DMI per 100 kg body weight and FCE of Holstein-Friesian crossbred and Sahiwal cow was  $15.40 \pm 0.19$  and  $12.61 \pm 0.16$  kg;  $2.76 \pm 0.03$  and  $2.91 \pm 0.03$  percent and  $0.51 \pm 0.00$  and  $0.49 \pm 0.01$ , respectively. There was ( $p < 0.01$ ) significant increase in DMI in T2 and T3 groups compared to T1 group.

The overall average Temperature Humidity Index (THI) was  $78.01 \pm 0.65$ ,  $74.89 \pm 0.39$ ,  $76.26 \pm 0.39$ ,  $76.26 \pm 0.39$ ,  $80.7 \pm 0.61$ ,  $85.04 \pm 0.64$ ,  $82.80 \pm 0.53$  and  $79.17 \pm 0.22$  for 1st fort night (FN), 2nd FN, 3rd FN, 4th FN, 5th FN, 6th FN, 7th FN and 8th FN, respectively. The average THI value for ILF(C) was  $78.14 \pm 0.97$ ,  $74.99 \pm 0.56$ ,  $76.26 \pm 0.56$ ,  $77.69 \pm 0.70$ ,  $80.90 \pm 0.93$ ,  $85.25 \pm 0.96$ ,  $82.93 \pm 0.77$  and  $79.52 \pm 0.28$  and For Sahiwal cattle farm, it was  $77.87 \pm 0.90$ ,  $74.79 \pm 0.56$ ,  $76.26 \pm 0.56$ ,  $76.26 \pm 0.56$ ,  $80.5 \pm 0.81$ ,  $84.83 \pm 0.88$ ,  $82.66 \pm 0.74$  and  $78.82 \pm 0.33$  during 1st FN, 2nd FN, 3rd FN, 4th FN, 5th FN, 6th FN, 7th FN and 8th FN. There was significantly ( $p < 0.05$ ) highest THI was found during 6th FN.

The average respiration rate, pulse rate, rectal temperature and rumination time in T1, T2 and T3 groups was  $26.84 \pm 0.54$ ,  $26.22 \pm 0.39$  and  $26.22 \pm 0.39$  per min;  $80.33 \pm 2.02$ ,  $67.52 \pm 1.31$ ,  $65.17 \pm 1.30$  per min;  $102.1 \pm 0.17$ ,  $101.4 \pm 0.10$  and  $100.69 \pm 0.08$  °F and  $405.7 \pm 3.30$ ,  $425.59 \pm 4.45$  and  $438.88 \pm 4.45$  min/day, respectively and for Holstein-Friesian crossbred and Sahiwal cows, it was  $27.00 \pm 0.31$  and  $25.85 \pm 0.41$  per min;  $74.44 \pm 1.45$  and  $68.11 \pm 1.41$  per min;  $101.38 \pm 0.11$  and  $101.48 \pm 0.12$  °F and  $422.92 \pm 3.33$  and  $423.85 \pm 3.21$  min/day, respectively. There was highly significant ( $p < 0.01$ ) decrease in pulse rate, rectal temperature and increase in rumination time in T2 and T3 groups than the T1 group. But respiration rate was not affected by treatment in the present study. The average blood albumin, globulin and A: G ratio in T1, T2 and T3 groups was  $5.28 \pm 0.21$ ,  $7.36 \pm 0.27$  and  $8.47 \pm 0.48$  g/dl;  $5.36 \pm 0.21$ ,  $6.91 \pm 0.32$  and  $7.97 \pm 0.33$  g/dl and  $1.01 \pm 0.03$ ,  $1.19 \pm 0.07$  and  $1.09 \pm 0.05$ , respectively and for Holstein-Friesian crossbred and Sahiwal, it was  $6.56 \pm 0.29$  and  $7.51 \pm 0.32$  g/dl,  $6.35 \pm 0.25$  and  $7.13 \pm 0.26$  g/dl and  $1.12 \pm 0.04$  and  $1.07 \pm 0.04$ , respectively. There was highly significant ( $p < 0.01$ ) increase in blood albumin and globulin content in T2 and T3 group compared to T1 group in the present study. The average superoxide dismutase (SOD) level of plasma for T1, T2 and T3 groups was  $8.06 \pm 0.10$ ,  $7.48 \pm 0.13$  and  $7.27 \pm 0.22$  unit/mg of protein, respectively and for Holstein-Friesian crossbred and Sahiwal, it was was

7.69±0.15 and 7.52±0.11 unit/mg of protein, respectively. In the present study, it was found that there was significant ( $p<0.05$ ) reduction in superoxide dismutase level of blood in T2 and T3 group compared to T1 group. The overall mean digestibility coefficient of DM, OM, CP, EE, CF and NFE in T1, T2 and T3 group was 67.05±0.15, 68.26±0.16 and 68.48±0.15; 68.46±0.17, 65.11±0.24 and 68.88±0.15; 64.89±0.24, 65.11±0.24 and 64.70±0.28; 53.69±1.19, 53.57±0.76 and 56.61±0.39; 59.67±0.20, 59.94±0.24 and 60.04±0.21 and 73.74±0.25, 74.74±0.25 and 76.71±0.15 percent, respectively and for Holstein-Friesian crossbred and Sahiwal cows, it was 68.10±0.14 and 67.76±0.17; 68.61±0.12 and 68.47±0.14; 65.01±0.13 and 64.79±0.26; 56.27±0.39 and 52.98±0.87; 60.10±0.18 and 59.67±0.17 and 75.02±0.25 and 75.11±0.27 percent, respectively. The analysis of variance showed non-significant ( $p>0.05$ ) effect of treatment, breed and fortnight on digestibility coefficient of DM, OM, CP, CF and NFE. But in case of EE, there was highly significant ( $p<0.01$ ) effect of treatment and breed on digestibility coefficient of EE. There was highly significant ( $p<0.01$ ) effect of treatment and breed on the average daily cost of feeding and cost of feeding per kg milk yield. The mean cost of feeding and cost of feeding per kg milk yield for T1, T2 and T3 group was Rs. 212.27±3.70, 262.37±2.82 and 302.25±3.31 and Rs. 36.13±0.78, 31.43±0.27 and 32.17±0.58, respectively. Though the total cost of feeding for T3 group was found to be significantly ( $p<0.01$ ) higher due to feeding of bypass fat, but cost of feeding per kg milk yield was significantly ( $p<0.01$ ) lower in T2 and T3 group compared to T1 because of higher milk production. In respect of breed, the daily cost of feeding and cost of feeding per kg milk yield in HF crossbred was significantly higher than pure Sahiwal cows.

The present experiment validated that heat stress can be ameliorated significantly by body cooling and feeding bypass fat during summer season for improvement of milk production and maximize the income from rearing of dairy cattle.

## **Effects of Different Methods of Smoking and Levels of Fat on Certain Quality Characteristics of Buffalo Meat Sausages**

*Anindita Mali*

Buffalo meat sausages were developed employing different methods of smoking and levels of fat to obtain a healthy product with good shelf-life properties and economic feasibility. Three primary treatment groups were prepared, namely- T1 (20% fat), T2 (10% fat + 10% inulin), T3 (7.5% fat + 12.5% inulin), which were subjected to three subgroup A (Conventional smoking), B (3% Liquid smoke), C (7% Liquid smoke). The control was prepared with 20% fat without any sub-treatments. 5 batches of buffalo meat sausages were prepared and evaluated for various important qualitative parameters on the 1st, 7th, 14th, 21st and 28th day of refrigerated storage, including estimation of PAH and cost of production.

The ES and CY were seen to significantly increase with the replacement of fat with inulin and the highest was observed in the treatment group T3. The pH value decreased significantly ( $P < 0.05$ ) in all the treatments in comparison to the control, the lowest of them being T2A ( $5.69 \pm 0.09$ ). With higher inclusion of inulin, the aw, and WHC significantly ( $P < 0.05$ ) increased in the treatment. The TBARS values were significantly ( $P < 0.05$ ) lower in the treatment group T3, ranging (from  $0.30 \pm 0.02$  to  $0.34 \pm 0.03$ ). The tyrosine value did not vary significantly among the control and treatments. However, T3B ( $10.14 \pm 0.38$ ) and T3C ( $10.10 \pm 0.44$ ) were significantly lower. The proximate analysis depicted treatment T3C to have the highest moisture content of  $68.62 \pm 0.45$ . The protein content did not vary significantly between the control and treatment and ranged from 19.05 to 19.72%. The fat content reduced from  $19.12 \pm 0.46$  to  $8.08 \pm 0.33$  when inulin was substituted for fat. The highest fat per cent was observed in T1A ( $19.12 \pm 0.46$ ) and the lowest in T3C ( $8.08 \pm 0.33$ ). The ash content increased from  $1.04 \pm 0.07$  (control) to  $2.63 \pm 0.06$  (T3C) with the addition of inulin at higher percentages. The lowest calorific value was obtained in T3C ( $155.79 \pm 1.42$ ), corresponding to the lowest level of added fat.

The mean log<sub>10</sub> cfu for total plate count showed significant ( $P < 0.05$ ) differences between the control and other treatments, without any significant difference

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among the treatments. The buffalo meat sausages were not detected for *E. coli*, yeast and mould, Salmonella and *Staphylococcus*.

The TPA results showed that with higher inclusion of inulin as a fat replacer, the hardness, springiness, chewiness and resilience significantly increased. However, cohesiveness was not significantly affected. The colour profile study depicted a significant increase in the L\* value, with higher inclusion of inulin ( $54.95 \pm 0.22$ ) in T3B; however, the a\* values were inversely co-related to L\*. The b\* did not vary between treatments and control, except for treatment T3C.

The estimation of PAH depicted that the potent carcinogen Benzo(a)pyrene was absent in control and all the treated samples. However, the PAH compounds, Fluoranthene and Chrysene, were observed in the samples in both conventionally smoked and liquid smoke added products. The concentration of Fluoranthene differed significantly and was found to be the lowest in T1B ( $15.10 \pm 0.00$ ) and the highest in T2C ( $53.47 \pm 9.04$ ), while Chrysene content did not vary significantly and ranged from ( $32.27 \pm 0.97$  to  $38.37 \pm 1.77$ ).

Considering the above parameters, T2 was found to be better than other treatment groups, and therefore the sausage samples of T2, along with the control, were subjected to the organoleptic evaluation. The subjective evaluation revealed that the conventional smoking treatment T2A had the highest scores for appearance, colour, flavour, texture and overall acceptability. ii

The developed buffalo meat sausages were found to be stable for up to 21 days under vacuum packaging at a refrigeration temperature ( $4 \pm 10$ C), after which the microbial counts exceeded the FSSAI standards. The cost of production was calculated based on the market prices of the raw materials. The highest was observed for T3C (Rs. 763.45/kg), while the lowest was for control (Rs. 518.00/kg). Based on the findings of the present study, treatment group T2, in particular, T2A, was the best among all the treatments.

## Detection and Deactivation of Antimicrobial Residues in Pork

*Param Debbarma*

The present study aims to detect antimicrobial residues in collected pork samples, isolation and *in-vitro* study of the resistance pattern of meat-borne pathogens (*Escherichia coli*, *Salmonella spp.* and *Staphylococcus aureus*) against 12 commonly used antimicrobials in pig husbandry and effect of different cooking methods (*viz.* boiling, roasting and microwaving) on deactivation/inactivation of antimicrobial residues.

The preliminary screening of 261 pork samples by microbial inhibition assay using endospores of *Bacillus subtilis* MTCC 441 as test organism revealed that none of the samples were positive for antimicrobial residues except 3 (three) which were doubtful to have traces of antimicrobial residues.

A total of 80 pork samples were further screened by Ultra-Fast Liquid Chromatography system (Model: Shimadzu Prominence LC-20AD, Detector-SPD-20AUV/ Vis; C18 Column: BDS Premium, 250 mm x 4.6 mm, 5 m) to detect OTC, TTC, CIP and GEN residues. OTC and CIP residues were detected in 2.5% and 1.25% of the samples, while none of the samples detected TTC and GEN residues.

The overall recovery rate of *Escherichia coli*, *Salmonella spp.* and *Staphylococcus aureus* from the pork samples were 28.75%, 9.09% and 31.25%, respectively. All the isolates showed variable ranges of resistance against the tested antimicrobials. Highest resistance was recorded against ampicillin (75-100%), followed by trimethoprim (37.5-100%), cefepime (25-75%), nalidixic acid (12.5-62.5%), sulfafurazole (0-37.5%), ciprofloxacin (0-37.5%), chloramphenicol (0-37.5%), ceftriaxone (0-25%) and amoxiclav (0-12.5%). All the isolates however, recorded 100% sensitivity against amikacin, gentamicin and tetracycline.

The effect of cooking *viz.* boiling, roasting and microwaving revealed significant reduction ( $p < 0.001$ ) in the residual concentration of antimicrobials (OTC, TTC, CIP and GEN). Cooking by microwaving recorded highest reduction (44.48-91.06%) followed by roasting (32.11-85.92%) and boiling (22.02-73.33%). Thus, cooking temperature and time can have a significant effect on the losses of antimicrobial residues and provides an additional safety margin to the consumers.

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# **Effect of Rice Beer and Phyto-Ingredients on Certain Quality Characteristics of Duck Meat Product**

*Pompi Rani Boro*

The study was conducted in the Department of Livestock Products Technology, Assam Agricultural University, Khanapara, Guwahati-22 to develop a duck meat product incorporating rice beer, phyto-ingredients and spices as marinating ingredients along with control without affecting the physico-chemical, microbial, organoleptic qualities and shelf life of the meat.

A total of five batches of marinated duck meat comprising of 4 different treatments in each batch were prepared. Ducks were collected and slaughtered hygienically and marinated. The marinades were prepared by using rice beer, spice paste and phyto-ingredients. The marinated samples are grouped into following treatments for control (meat and spice paste), Treatment 1 (meat and rice beer), Treatment 2 (meat, phyto-ingredients and spice paste) and Treatment 3 (meat, spice paste, rice beer and phyto-ingredients). The marinated samples were vacuum and aerobically packed and stored in refrigeration temperature for 24 hrs. After these periods, the samples were subjected to various quality assessments. Shelf life studies conducted at interval of 5 days for vacuum packed samples, whereas, aerobically packed samples were assessed for shelf-life studies at an interval of 3 days. The results of the investigation are as follows:

The alcohol content (%) of rice beer found to have  $6.02 \pm 0.2$ . The pH value was  $3.58 \pm 0.09$  and the antioxidant activity (%) was found to have  $16.12 \pm 0.13$ .

The results with respect to pH, tyrosine and TBA of marinated duck meat were found to be significantly ( $P < 0.01$ ) higher when compared to control samples. Mean cooking yield was found to be higher in control samples as compared to the treated samples. The cooking yield was significantly lower in treated samples as compared to that of control samples.

The mean percent of proximate composition of products showed similar trend for both aerobic and vacuum packaging systems. Moisture was high in the Treatment 3

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samples as compared to that of control samples, whereas, crude protein, ether extract and total ash was high in control samples. The mean values of moisture, crude protein, ether extract and total ash showed significant differences among the control and treated samples but no significant effect could be seen in both the packaging conditions.

The mean values of colour profile showed no significant differences between the control and treated samples and also no significant effect in both the packaging conditions. The data generated for aerobic packaging method revealed marginally higher L\* values. The L\* value was lower for treated products than that of control products. Redness (a\*) followed a decreasing trend in all the treated products as well in control products. Slight decrease in yellowness in vacuum packaged duck meat products. ii The mean values of texture profile also showed similar trend in both the packaging systems. The hardness values showed a decreasing trend in treatment 3 as compared to control samples in both the packaging systems. However hardness values were marginally lower in vacuum packaged samples when compared to aerobically packaged samples. Significant differences ( $P < 0.01$ ) could be observed in the control and treated samples for springiness and chewiness, whereas, cohesiveness followed an increasing and decreasing trend and no significant ( $p > 0.05$ ) differences among all the treated samples. The resilience followed uniformly decreasing trend from control to T3 samples The sensory evaluation showed no significant differences (Appearance, colour, flavour and tenderness), whereas, significant differences were observed for juiciness and overall acceptability. The microscopic study in both (scanning electron microscope and light microscope ) revealed swelling of muscle fiber and decrease in inter fibrillar spacing between the muscle fibers and disruption of connective tissue membranes due to use of marinating ingredients. The microbiological quality studies revealed that there is a significant increase ( $P < 0.01$ ) in control samples compared to treated samples during the entire storage periods in both the packaging systems, whereas, total psychrophilic count could not be detected on 1st and 5th day of storage in vacuum packaging but on 10th and 15th day it increases in the storage periods. Similarly for aerobically packaging systems, TVPBC were not detected on 1st day of storage but on 3rd, 5th and 7th day of storage it increases in the storage periods. The Yeast and Mould count and Coliform count were absent in all the storage periods in both the packaging systems. The Sulphite Reducing *Clostridial* organisms and salmonella were also found to be absent in all the samples for both the packaging systems. The shelf life studies of marinated duck meat were studied on the basis of pH, tyrosine, TBARS value, microbiological quality and visible colour and odour changes of the products at refrigeration temperature. Vacuum packaging system was found to be better than the aerobic packaging system. Based on the investigation, it can be concluded that an acceptable marinated duck meat product can be developed for future commercial exploitation.

## **Interaction Studies of Microbial Enzymes and Phytochemicals of *Bael* (*Aegle marmelos*) in Flavour Enhancement of Cow's Milk Ghee**

*Rashmi Rekha Saikia*

A study was conducted to develop flavour and colour enhanced cow's milk ghee using starter cultures as a source of microbial enzymes and phytochemicals of *bael* (*Aegle marmelos*) fruit pulp extract. The experiment was conducted in the laboratories of the Department of Livestock Products Technology, the All India Coordinated Research Project on Post-Harvest Engineering and Technology, the Department of Livestock Production and Management, the Department of Veterinary Biochemistry, College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati-781 022; and the Central Analytical Instrumentation Facility, Guwahati Biotech Park Incubation Centre of the Indian Institute of Technology, Amingaon, Kamrup, Guwahati-781 031 during the period from August 2020 to April 2022.

*Lactococcus lactis* ssp. *lactis* var. *diacetylactis* and yoghurt cultures of *Streptococcus thermophilus* and *Lactobacillus delbrueckii* ssp. *bulgaricus* were used @ 3% (v/v) in the study. *Bael* pulp extract was added @ 1% (v/v) to the treatment groups.

Cow's milk ghee was prepared by the heat clarification method. The flavour and colour qualities, FFA contents, antioxidant compounds, sensory attributes, proximate composition and shelf-life of the cow's milk ghee thus prepared were studied. The ghee was stored at ambient temperature to study the shelf-life.

A total of 34 flavour compounds were detected in the samples of the treatment groups as well as the reference sample by GC-MS studies. Identical numbers of FFA were also detected in the ghee samples. The flavour of the ghee was attributed by the FFA along with the other flavouring compounds like the alcohol, hydrocarbons, ketones, terpenoids, organic acids and 9 other compounds identified in the ghee samples.

Ascorbic acid, thymol, phytol and  $\beta$ -sitosterol were the four antioxidant compounds detected by GC-MS. The maximum radical scavenging activity ( $60.160 \pm 0.541\%$ ) was observed in the sample of T<sub>4</sub>. *Bael* pulp extract added ghee

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samples had higher DPPH inhibition activity as compared to the other groups and the reference sample.

Colour component  $b^*$  was found in higher values in *bael* pulp extract added ghee samples. Highly significant positive correlation was found between the sensory evaluation scores for colour and the colorimetric assessment of the colour components ( $b^*$  value).

Higher panel ratings for flavour and colour of the samples of T<sub>4</sub> group indicated that *bael* pulp extract indeed had a positive effect on the flavour and the colour characteristics of cow's milk ghee.

The moisture and ash contents of the ghee were highly significantly influenced by the starter cultures and addition of *bael* pulp extract while only significant difference could be found in their protein content.

Shelf-life study was done based on the FFA and peroxide values. Correlation studies revealed a highly significant difference between FFA and PV while a negative correlation existed between the FFA x antioxidant activity and PV. A gradual increase in FFA and PV along with the increase during the storage period was found in all the treatment groups. Even after 6mon of storage, FFA and PV were found to be much lower than those recommended by the FSSAI (2016).

From the study it was found that the starter culture *Lc. lactis* ssp. *lactis* biovar *diacetylactis* used in the study in combination with the *bael* pulp extract produced cow's milk ghee with improved flavour and colour attributes and had an extended shelf-life at room temperature.

## **Development of Ready-to-Cook Chicken Chips Using Spent Hen Meat Incorporated with Fenugreek Seeds and/or Leaves Powder**

*Dimpi Choudhury*

A study was carried out to develop ready-to-cook chicken chips utilizing spent hen meat incorporated with fenugreek seeds and/or leaves powder. For this study twenty numbers of healthy spent hens were used following standard protocols for slaughtering and processing.

Fenugreek (*Trigonella foenum graecum*) seeds and its fresh leaves were purchased from local market of Guwahati city and processed to powdered form and stored for further use. The fenugreek leaves and the seeds were analyzed for proximate parameters. The fenugreek leaves contained  $85.64 \pm 0.72$  % moisture,  $4.62 \pm 0.14$ % protein,  $0.94 \pm 0.01$ % ether extract,  $1.69 \pm 0.13$ % crude fibre and  $10.73 \pm 0.12$ % total ash. While the fenugreek seeds contained  $10.26 \pm 0.15$ % moisture,  $26.86 \pm 0.10$ % crude protein,  $10.72 \pm 0.15$ % ether extract,  $47.52 \pm 0.39$ % crude fibre and  $3.82 \pm 0.07$ % total ash.

The qualitative phytochemical studies of fenugreek seeds and leaves revealed presence of steroids, phenols, tannins, flavanoids, alkaloids and saponins. The antioxidant activity against DPPH radical, total phenolic content and ferric reducing activity of the fenugreek seeds and leaves were studied using ethanolic extract. The mean per cent values of inhibition of DPPH radical by ethanolic extract were observed to be  $51.40 \pm 2.27$  and  $64.39 \pm 1.73$ % for fenugreek leaves and fenugreek seeds, respectively. The total phenolic content in ethanolic extract of both fenugreek leaves and fenugreek seeds were recorded as  $5.16 \pm 0.06$  and  $15.13 \pm 0.02$  mg GAE/g, respectively. The mean ( $\pm$ SE) ferric reducing activity by ethanolic extract of both fenugreek leaves and fenugreek seeds were found to be  $0.35 \pm 0.03$  and  $0.65 \pm 0.04$ , respectively and thus exhibit remarkable antioxidant activity.

The antibacterial activities of both extracts (fenugreek leaves and seeds) exhibited positive reaction against *Staphylococcus aureus* and *Klebsiella* spp. at different concentrations showing zones of inhibition ranging from 10 to 19 mm. The extracts of fenugreek seeds exhibited anti-bacterial effect against *E. coli* but no effect

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could be found with fenugreek leaves. Moreover, no antibacterial activity could be observed against *Salmonella* spp. by fenugreek leaves as well as fenugreek seeds.

The research trials were continued in two Phases, i.e., I and II. Under Phase I chicken chips was prepared as per standard formulation incorporating fenugreek seeds and/or leaves @ 0.25, 0.50 or 1.00 % level. The products were stored in sealed LDPE bags at ambient temperature ( $37 \pm 2^{\circ}\text{C}$ ) for a period of 30 days. The samples were evaluated for the physicochemical, proximate and sensory parameters at a regular interval of 10 days starting from 0th day, till 30th day.

The moisture level in all the treatment groups for fenugreek leaves as well as seeds including that of Control progressively increased as storage period extended till 30th day. The protein percentage in the treatment groups with increase in fenugreek seeds level (0.25, 0.50 and 1.00%) showed to have increased as compared to the Control and the values ranged from  $22.33 \pm 0.22$  to  $22.85 \pm 0.09\%$ . The analysis revealed no significant ( $P > 0.05$ ) differences among the various treatment groups incorporated with fenugreek seeds powder. The data analysis revealed no significant ( $P > 0.05$ ) differences in ether extract among the various treatment groups incorporated with fenugreek leaves powder and control group and with increasing storage period. Significant changes ( $P < 0.05$ ) in total ash content could be noted in the Treatment groups with fenugreek seeds with increase in the level of fenugreek seed powder (0.5 and 1.0%).

Significant increase in pH could be seen on 30th day of storage in all the treatment groups including that of Control. The impact of storage could not be noticed in the products made of, either leaves or seeds in terms of tyrosine value. The water activity remained unchanged till the 20th day of storage, however increased significantly ( $P < 0.05$ ) on 30th day whereas no change observed among the treatment groups for both fenugreek leaves and seeds addition. The cooking yield of  $90.97 \pm 0.76\%$  to  $95.00 \pm 1.77\%$  range was recorded in the chicken chips incorporated with fenugreek leaves and fenugreek seeds powder.

The freshly prepared chicken chips with addition of fenugreek leaves and seeds on day 1 exhibited 'good' colour, texture, crispiness scores under hedonic scale. The sensory evaluation of the chicken chips product treated with fenugreek seeds and leaves powder showed low for flavor, after-taste scores and overall acceptability in the Treatment II (FL with 0.50%), III (FL with 1.00%) and Treatment V (FS with 0.50%) & VI (FS with 1.00%) groups throughout the storage period of 30 days.

Under Phase I trial, based on the statistical analysis obtained, two best groups FL with 0.25% and FS with 0.25% along with combination of both (FL+FS with 0.25 each) were selected for further studies. All the physicochemical values for the treatment groups were found to be under desirable ranges. Significant increase in the moisture level was found on 30th day of storage as compared to the 0th, 10th and 20th day however, no changes were observed among different treatment groups.

The crude protein values ranged from  $22.36 \pm 0.02$  to  $23.03 \pm 0.06\%$  among all treatment groups. Significantly ( $P < 0.05$ ) high crude protein was recorded in the Treatment A (FS with 0.25%) and Treatment C (FL, FS 0.25% each) when compared

with Control. The ether extract and total ash content in chicken chips revealed nonsignificant ( $P>0.05$ ) changes when compared with the Control group.

Storage days showed significant ( $P<0.05$ ) effect on pH of the products and treatment with combination of fenugreek leaves and seeds significantly showed lower ( $P<0.05$ ) pH on 30th day when compared with 0th to 20th day of storage. There was no significant difference between the treatment groups and Control group throughout the storage period and the values remained far below permissible limit for all the products. The analysis of variance showed significant difference ( $P<0.05$ ) in water activity values on 30th day of storage compared to the aw on the 0th, 10th and 20th day of storage. There was no significant ( $P>0.05$ ) change in cooking yield of the treatment groups with increase in storage period and among the different treatment groups. The TBA values decreased significantly ( $P<0.05$ ) on the 10th day of storage and remained static thereafter up to 30 days of storage. The cholesterol content of ready-to-cook chicken chips using spent hen with addition of fenugreek seeds and fenugreek leaves are found to be as  $30.55 \pm 0.14$ ,  $30.45 \pm 0.21$ ,  $30.39 \pm 0.16$  and  $31.44 \pm 0.14\%$  for Control, T-A, T-B and T-C, respectively with no significant ( $P>0.05$ ) changes among the groups. The colour profile for the chicken chips showed significant differences only in  $L^*$  values while no changes observed in  $a^*$  and  $b^*$  values. A significant increase in mean DPPH activity was noted in all the treatment groups incorporated with fenugreek leaves and seeds powder revealing its potential antioxidant capacity.

The total plate count analyzed for the products were within the limits and were free from Coliform, Salmonella, Staphylococcal bacteria and yeast and mould which ensures the microbial safety of the product.

No significant difference was noticed for colour, texture, crispiness characteristics among the Control and treatment groups but could retain 'good' to 'very good' scores for the product. The chicken chips under all treatment groups scored very less scores in terms of flavour, after-taste and overall acceptability with increase in levels of fenugreek leaves and seeds powder. The chicken chips prepared with the incorporation of spent hen and fenugreek leaves or seeds have revealed good antioxidant profile without any noticeable changes in any other physico-chemical parameters and microbiological profile. Fenugreek leaves at 0.25% level can be effectively used in chicken chip preparation using spent hen meat with 'good' acceptability having cost of production of ` 7.45 per 30g of the product. It could be concluded that a level of 0.25% fenugreek leaves powder can effectively be incorporated in production of ready-to-eat chicken chips as functional food having added health benefits.

## **Ph.D (Home Science)**

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- **Extension and Communication Management**
  - **Family Resource Management**
  - **Food Science and Nutrition**
- **Human Development and Family Studies**
  - **Textile and Apparel Designing**

## **Empowerment of Rural Women in Vegetable Production for Nutritional Security**

*Divya Sachan*

Rural women play an important role in both household and socio economic development of the society. Development of any nation will be impossible without developing this important and substantial segment of our society. Women perform a perceptible role in a variety of agricultural operations. They are actively involved in the cultivation of various crops, as well as vegetable production and kitchen gardening. Realizing the importance of rural women in vegetable production and knowing the extent of training needs of these rural women, the study entitled —Empowerment of rural women in vegetable production for nutritional security‡ was planned with following objectives: To study the work profile of rural women in homestead gardening. To assess the existing knowledge and practice of rural women on vegetable production. To empower rural women in vegetable production through intervention and assess its impact. The present study was conducted in Jorhat district of Assam state. From Jorhat sub-division three blocks namely Kaliapani, Dhekorgorah and Chipahikhola were selected for the study. From each block three villages were selected and from each village 50 respondents were selected by simple random sampling method who were involved in vegetable production activities. Thus all total four hundred fifty (450) rural women from nine villages were the respondents for the present study. The study revealed that majority of the rural women were of middle age group (58.22%), married (91.55%), educated up to middle school level (31.56%) belonged to OBC/MOBC category (73.77%) had nuclear type of family (80.23 %), were having farming as their main occupation (38.89%), had agricultural land 1-3 bigha (38.00%) majority of them had pucca house (48.22%). More than 69 per cent had medium socio-economic status. All the respondents were using biocompost as their main source of fertilizer, had poor contact with extension personnel, lack of time due to over burden of household work was the main problem faced by the respondents in attending training programme. Majority (63.77%) of the respondents had medium level of participation in different activities of production of vegetable crops, had medium level of participation in decision-making (64.22%). Majority (76.00%) of the respondents had medium level of knowledge about vegetable production. The percentage of respondents belonging to the

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low category of knowledge was higher (21.55%) in the area of land preparation in comparison to other aspects of vegetable production. In case of practice, majority (64.89%) of the respondents had to moderate level of practice regarding vegetable production and 31.33 percent had poor level of practice in plant protection. Selection of respondents for the intervention programme was done from that block where percentage of respondents belonging to lower level of existing knowledge in vegetable production was found more. After intervention gain in knowledge score was 29.34. The impact of intervention programme was found to be highly significant (tvalue-46.56\*\*) in terms of gain in knowledge. Data regarding existing practices and adoption of practices shows an increase in adoption of practices score (11.57) after 30 days of intervention programme and there was also a highly significant difference between pre exposure practice score and post exposure practice score. Keywords: Empowerment, Rural women, vegetable production, Nutritional Security, knowledge and practice etc.

# **Occupational Health Hazards of Tribal Farm Women of Assam in Farming and Household Activities**

*Rashmi Rekha Kalita*

The present investigation into the occupational health hazards of tribal farm women in Assam in farming and household activities was carried out in three agro-climatic zones from the Brahmaputra Valley Zone. A multi-stage purposive simple random sampling design was followed for sample selection. One district from each zone, namely Majuli of the Upper Brahmaputra Valley Zone, Morigaon of the Central Brahmaputra Valley Zone and Kokrajhar of the Lower Brahmaputra Valley Zone, was selected purposively where majority of the tribal people live. From the one district, one subdivision and from one subdivision, one block was selected. From the selected three blocks, two villages were selected from each of the blocks. Thus, six (06) villages were selected for the study. From each of the villages, fifty (50) respondents were selected randomly. A total of 300 tribal farm women were selected randomly who were engaged in farming and nonfarm activities for the present study. Data collection was done by using a structured interview schedule. The study revealed that the majority of the tribal farm women (43.66%) were from the middle aged group (36-46 years) and married (83.67%). The majority of tribal farm women (75.00%) had farming as a family occupation, followed by 64.67 percent of marginal farmers, 72.33 percent of nuclear families and 61.33 percent of medium socioeconomic status. 66.00 percent of respondents had occasional contact with the ADO/Agricultural Office and 60.00 percent had attended various agriculture-related training programmes on a regular basis. In the case of pre-harvesting activities, the majority of tribal farm women independently participated in mulching (71.00%) and jointly participated in transplanting, planting, and sowing of seeds (70.00%). In the case of farming, 86.66 percent independently participated in seed cleaning and 49.00% jointly participated in seed storing. Regarding household activities, the majority of tribal farm women participated independently in preparation of cooking (96.67%) and jointly in the care of children or elderly (41.00%). It also indicated that weaving (93.33%) and piggery (65.33%). Tribal farm women spent the most time on land preparation (6 hours per day). Regarding Physiological Problems,

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Headache was ranked as I with a mean score of 0.93. 66.00 per cent of the respondents had a medium level of awareness and 100.00 per cent of the respondents used improved Kohona. The data revealed that an awareness camp should be organized on health hazards: rank as I, have a mean score of 1.81. Time utilization and body discomfort have significant associations with selected farming and household activities.

# **Role of Self Help Groups (SHGs) in Rural Development with special reference to Jorhat district of Assam**

*Sadala Rajasri*

Women empowerment has become a meme in the global governance network. In this context, SHGs have emerged as the tools that wield power to create a socio-economic revolution in the rural areas of our country. SHGs set as the building blocks of organizing poor and disadvantaged households in the community. SHGs have not only produced tangible assets and improved living condition of members but also help in changing much of their outlook, world view and attitude.

The present study entitled Role of Self Help Groups (SHGs) in Rural Development with special reference to Jorhat district of Assam with the objectives: i) To study the organizational structure and functioning of the selected SHGs, ii) To find out the various sources of fund and their pattern of expenditure, iii) To study the impact of selected SHGs on socio-economic empowerment of rural women and iv) To explore suggestions for the effective functioning of SHGs in improving the socio-economic status of rural women.

A sample of 60 SHGs consisting of 300 members have taken to study the various aspects of the SHGs. A multistage purposive cum simple random sampling method was adopted.

It was found that most of the SHGs (76.67 per cent) were promoted by Government organizations, established during the year 2000-2005 (50.00 per cent), had constitution for conducting their regular activities (93.33 per cent) and members belonged to residents of the same village where SHGs were located. Majority of the SHG groups (66.66 per cent) had 10-15 members. Nearly 50.00 per cent of the SHGs did not have any fixed tenure of service of office bearers. Higher percentage of respondents from SHGs were motivated for avail the loan (90.00 per cent). It was found that meetings were conducted on monthly basis. Majority of the SHGs (83.34 per cent) expressed of holding the meetings in the afternoon. 66.67 per cent SHGs reported that there is no fixed time of the duration of SHGs meetings. 93.34 per cent were conducting meetings at their office bearers residence. 58.33 per cent of SHGs were reported to

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impose no fine for absenteeism followed by 33.33 per cent SHGs imposed penalty of Rs. 5 and 8.33 per cent of Rs.10 for absenteeism . 88.33 per cent of the SHGs were found to be regular in their contribution towards savings. Monthly interest rate was 2 % for 75 per cent of selected SHGs. 58.33 per cent charged 5% from outside group 6 members. 90 per cent SHGs had kept records with respect to internal loan and interest (95.00 per cent). Majority of the SHGs (55.00 per cent) did not to have provision of verification of accounts for which misunderstanding among the members were seemed to be developed gradually. 50.00 per cent of SHGs received training on maintenance of records. Majority of the SHGs did not received any kind of training for proper function of SHGs. 73.33 per cent SHGs were found to raise their income mainly from government fund to implement some socio-economic activities, while, 70.00 per cent relied on its membership subscription. 73.33 per cent had spent their funds in traveling to collect important information, attending meetings, visiting banks etc. from different related organization/institutions. 54.66 per cent of the respondents belonged to middle aged (between 36-55 years). 50.33 per cent of rural women in SHGs were holding 1.0 acre-4 acres of land, educated upto HSLC (40.33%) followed by primary school( 41.00 %) Independent profession was the major occupation (47 per cent) of the members of SHGs. Majority (82.00 %) of the SHGs members belonged to nuclear family. Rural women moved from their house for social visit, attending bank, and block which were ranked as I, II, and III. After joining SHGs, all the respondents were empowered to take decision on marketing of prepared products (100%) and 49.33 per cent of members had medium level of risk bearing abilities. Job reservation for women and punishing wicked husband, compulsory family planning and inter caste marriage were ranked as I, and II and III which were strongly approved social issues by all rural women. Lack of awareness regarding functioning of SHG ranked (I) with mean score 1.98 followed by lack of adequate training provided by the linked agencies, and lack of vocational/skill development training ranked (II) with a mean score 1.96 are the major problems faced by members. Majority of the respondents increased decision making power within their household (66.00%). medium (62.00 per cent) level of self confidence, not interacting with officials (53.33%) whereas after joining in SHGs, 13.33 per cent and 33.33 per cent sometimes had interacted with outsiders followed by not faced any family violence in their respective household (50%). It was also revealed that the status of access to amenities were increased (37.05%) after joining SHGs. 68.67% respondents were encouraged to take loans from SHGs / Govt. fund after joining SHGs. 70.00 per cent SHG members have increased their asset value after joining SHGs. The awareness of members about selection of micro enterprises (rank 1), and organize need based intervention programmes were (rank II) suggested by Government, NGOs officials and knowledgeable persons.

## **Ergonomic risk factors and occupational health of women engaged in kalamkari craft**

*Channamsetty Mahalakshmi*

The process of manufacturing kalamkari craft is a complex and time consuming one. It is produced through intricate artistic patterns by using different blocks and screens had its own hazards for the workers. Kalamkari industry is suffering for the way the workers work with an uncomfortable tools & equipment, work situation and environmental stresses, besides the incompatibility of man-machine interaction. The present study was designed with the following objectives: (1) To study the demographic and work profile of workers engaged in kalamkari craft. (2) To identify the work related musculoskeletal disorders among women workers. (3) To ascertain the ergonomic risk factors among the workers in different kalamkari activities. (4) To suggest ergonomic interventions to improve occupational health of the workers. Multistage sampling procedure was followed to select 180 female workers from Krishna district of Andhra Pradesh State, who are actively involved in kalamkari block printing and screen printing activities contributing 6-8 hours a day. A structured interview schedule was designed to collect information regarding ergonomic risk factors and occupational health of workers the Standard Nordic Questionnaire (SNQ), Body Part Discomfort (BPD) work place ergonomic risk assessment scale (WERA), job stain index (JSI), Quick Exposure Score (QEC), Rapid Upper Limb Assessment (RULA), OVAKO working posture analysis (OWAS), hand activity limit- threshold limit value (ACGIH-HAL –TLV) scale was used. The maximum number of respondents (33.33%) belonged to the middle age group of 31-40 years, studied up to intermediate level (35.56%) married (75.00%), living in nuclear family system (53.33%) and (43.33%) belonged to (SC/ST) category. Maximum respondents (36.11%) had low weight normal BMI and (65.33%) ‘mesomorph’ body type. Average MAP of respondents was 94.68 mmHg with SD  $\pm 5.18$  and pulse rate within the normal range. The block printing units and screen printing units had the average light intensity of 116 lux, and 295 lux. Sound level of (105 dB) and (76 dB) and temperature 38.6°C and 37.3°C respectively. The results of (SNQ) showed that workers felt ‘severe’ pain in wrist, shoulder and arms in (activity-1). ‘severe’ pain in arm, wrist, shoulder, lower back, mid back and upper back in (activity-3). ‘severe’ pain in wrist, arm, shoulder and in lower back in (activity-4). ‘severe’ pain in wrist, shoulder, arm in

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(activity-6). The results of (BPD) scale showed that workers felt pain in lower back (66.67%) upper back/ mid back (64.44%), shoulders (58.33%), wrist/hands (53.89%) in last 12 months. The workers prevented from doing work due to the pain in wrist/hands 1 (81.67%) in last 12 months. And during last 7 days pain in wrist/hands (40.56%) and lower back pain (36.11%). The JSI scores in block printing activity showed that total mean final score obtained for right hand was 40.5 and left hand 27. In screen printing the total mean score was observed to be 27 for both the hands which are higher risk and categorized as hazardous. The major health hazards workers experiencing in block printing was tingling of finger had mean highest score (3.7) followed by shoulder pain (3.7) stiffness in hand and joints (3.6) numbness of fingers (3.6) ranked I, II, III, IV respectively. In screen printing activity, shoulder pain (3.7) ranked highest followed by tingling of finger (3.7), stiffness in hand and joints (3.7), numbness of fingers (3.6) and ranked - II, III, IV respectively. The highest posture discomfort was observed while block printing with mean score 2.81 and ranked highest followed by screen printing with the mean score 2.74 ranked II. The percent exposure level of (QEC) showed a very high risk in block printing with the score of 69.13 percent and screen printing with the score of 66.04 percent respectively. The grand total score of (RULA) obtained for block printing and screen printing activities was (score-7). The average ratio score (ACGIHHAL –TLV) of highest in block printing activity with  $1.04 \pm 0.12$  and  $0.89 \pm 0.23$  in right and left hand. In screen printing activity, it was found to be  $0.57 \pm 0.31$  and  $0.56 \pm 0.61$  in right and left hand respectively. The block printing and screen printing were considered as —highly repetitive tasks as the cycle time obtained was within 30 seconds. The highest mean RPE scores was found in block printing activity (4.06) followed by screen printing (4.03). For the evaluation of the hand block tool, a participatory approach of the selected women was taken into confidence. Grip fatigue was found to be 12.15% and 10.14 % for the right hand and left hand as compared to the improved tool 8.54% and 6.73% for the right hand and left hand respectively. Pinch fatigue for existing tool 12.17 % and 10.57 % in right hand and left hand found compared to the improved tool 8.65% and 9.13% in right and left hand respectively. The results of (CHQ) Scores reveal that the tool is functional (6.2), fits the hand (6.1), easy in use (5.9), has a good force transmission (5.9), can offer a high task performance (4.8), provides a high product quality (4.2), needs low hand grip force supply (3.6), has a good friction between the handle and hand (2.7). The rate of perceived exertion felt by workers \_heavy\_ 84.44% with the existing hand block tool compared with the improved block 86.66% felt as \_light. It can be concluded that the improved design of the block would help in better functioning of the workers with more comfort and productivity.

# **Occupational factors and work-related Musculoskeletal Disorders among the commercial weavers**

*Geetashree Bori*

Handloom weaving provide the largest livelihood generation among the women weavers in Northeast India, specifically Assam. Women weavers constitute nearly 91.8% of the total workforce in handloom weaving in Assam. The present study was carried out to find out the occupational risk factors and work-related musculoskeletal disorders prevailing among the commercial weavers with these objectives – 1. To study the prevalent occupational risks in different types of handloom weaving in Assam; 2. To identify various work-related musculoskeletal disorders (WMSDs) and occupational health hazards among the weavers; 3. To understand the scope for effective intervention for occupational wellbeing of handloom weavers. A total of 180 women workers were selected for the study by following multistage purposive sampling procedure through a list of registered handloom weaving units of Lakhimpur District under Primary Weavers Cooperative Society (PWCS) and Self-Help Groups (SHGs). The commercial weavers face many challenges on the work-front regarding health-related issues as far as their workplace with three different types of looms are concerned i.e., throw-shuttle loom using dobby, frame loom using dobby and frame loom using jacquard. While performing the weaving activities the workers are found to assume variety of unnatural postures, repetition of task with force exerted for picking, battening and shedding operations, reaching for the dobby/jacquard and yarn breakage due to task demand and workplace arrangements. Various healthrelated risks and hazards that exists in different types of looms/workplaces are identified with the ergonomics tools assessment such as QEC, RULA, ACGIHAL-TLV, SI, grip strength and pinch strength. It was found that as the age of the respondents, years of involvement, perceived joint discomfort and occupational stress increases the WMSDs also increases. Frame loom using jacquard is the mostly used loom with 46.15 percent involvement of weavers and risk factors were also found high. To mitigate the risk factors and health issues, the present study proposed a workplace design intervention for an improved loom for better workplace conditions and occupational wellbeing of commercial handloom weaver. Providing an

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ergonomically designed workplace is important to the commercial handloom weavers as far as their occupational wellbeing is concerned. This is because motivated, healthy and job content workers at 7 workplace drives the performance, quality and competitiveness of an organization. Therefore, a predictive equation through regression model for an improve loom was provided for a comfortable seat height and holder dimensions. With the help of these equation, the seat height and the holder diameter for each weaver can be predicted according to their popliteal height and grip diameter inside thus providing ease and comfort to the weaver with improvement in the health condition. Evaluation for effectiveness of the improved loom was done with the help of spinal range of motion, grip strength, pinch strength, EMG analysis, body pain and ease of comfort. Significant reduction was observed in these parameters used for the improved loom. The improved loom was found to be in line to meet the objectives of the target beneficiaries.

## **Bioactivity of leaf extracts of *Simarouba glauca* and its hepatoprotective effect**

*Ashfeeka Islam*

The present investigation entitled “Bioactivity of leaf extracts of *Simarouba glauca* and its hepatoprotective effect” was carried out in order to study the proximate composition, phytochemical estimation, antioxidant activities of *Simarouba glauca* leaf extracts and its in vivo study for hepatoprotective activity. The leaf was collected from Assam Agricultural University and thereafter a series of laboratory experiments were carried out to fulfill the objectives of the present study. The fresh leaves were dried and powdered to carry out different analytical procedures. The nutrient composition of the *Simarouba glauca* leaf powder was determined where the moisture content was 9.01 gm/100 gm of the sample. The protein content of the leaf powder was 12.42 gm/100 gm, the fat was 4.33 gm/100 gm, the fibre was 27.95 gm/100 gm, the ash content was 3.29 gm/100 gm, the carbohydrate content was 39.81 gm/100 gm and the dry matter was 90.99 gm/100 gm of sample. The vitamin content of the *Simarouba glauca* leaf powder was evaluated where the presence of thiamin was 0.71 mg/100 gm, riboflavin was 0.42 mg/100 gm, niacin was 1.59 mg/100 gm, ascorbic acid was 22.1 mg/100 gm and vitamin A was 5.01/100 gm of the sample. Fluorescence was estimated in *Simarouba glauca* leaf powder under visible and ultra violet light at 245 nm. The leaf powder when treated with different reagents such as sodium hydroxide, sodium chloride, potassium hydroxide, sulphuric acid, nitric acid, acetic acid, chloroform, ethanol, methanol, iodine and water exhibited bright green, dark brown, brown, pale green, yellowish green, black, reddish brown, red, light yellow and green colour under visible day light and ultra violet light. The extraction yield of *Simarouba glauca* leaf extracts ranged from 1.87-2.30 per cent where the water extracts of *Simarouba glauca* leaf was highest (2.30 per cent) and it was lowest in methanol extracts of *Simarouba glauca* leaf (1.87 per cent). The preliminary phytochemical screening showed presence of flavonoids, terpenoids, phenols, anthraquinones and glycosides in the chloroform extracts of the leaf. Presence of alkaloids, flavonoids, terpenoids, steroids, tannins, phenols and glycosides were found in the ethanol extracts of *Simarouba glauca* leaf. The methanolic extract of *Simarouba glauca* leaf had alkaloids, flavonoids, terpenoids, steroids, tannins, phenols and glycosides. In the water extracts of *Simarouba glauca* leaf, presence of flavonoids,

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tannins and phenols was found. Quantitative analysis of phytochemical constituents was done where the total phenols ranged from 0.29-1.67 mg GAE/100 gm which was highest in the ethanolic extract and lowest in methanolic extract. The total flavonoid ranged from 0.303-0.497 mg QE/gm with the highest value in chloroform extract and lowest in methanol extract. The percentage inhibition of DPPH free radical scavenging activity was determined which showed maximum inhibition at increased concentration of the *Simarouba glauca* leaf extract. The per cent inhibition in chloroform extracts of the leaf were in the range of 69.64-91.60 per cent according to the increase in level of concentration from 100 - 500 mg. It ranged from 64.22-73.30 per cent in ethanolic extract, 59.85 – 90.50 per cent in methanolic extract and 30.41-83.52 per cent in water extracts of *Simarouba glauca* leaf with its increasing level of concentration. Antibacterial activity of *Simarouba glauca* leaf extracts was studied on *Pseudomonas aeruginosa*, *Salmonella typhi* and *Salmonella paratyphi*. Among the different concentration viz., 50, 100, 150, 200 and 250 mg/ml of chloroform, ethanol, methanol and water extracts of *Simarouba glauca* leaf were tested of which 250 mg/ml produced highest inhibitory activity against the three gram negative pathogens. The antibacterial activity of the chloroform and ethanol extracts of *Simarouba glauca* leaf showed highest inhibition of 20.67 mm and 18.33 mm at 250 mg/ml concentration respectively in *Salmonella typhi*. The zone of inhibition of methanol and water extracts of *Simarouba glauca* leaf was 23.33 mm and 15.33 mm respectively in *Pseudomonas aeruginosa* at 250 ml concentration which was the highest. The viability of HCT 116 cell lines with extracts of *Simarouba glauca* leaf was examined where the cell viability decreased with increase in concentrations of leaf extracts of *Simarouba glauca* hence increasing the per cent inhibition. The inhibition of chloroform, ethanol, methanol and water extracts of *Simarouba glauca* was highest at 450 µg/ml concentration which was 98.77 per cent, 96.89 per cent, 98.93 per cent and 98.84 per cent respectively. Acute toxicity study on experimental animals showed no change in behavior, eating habit, sleep and mortality on administration of different dosage of chloroform, ethanol, methanol and water extracts of *Simarouba glauca* in two phases of the experiment. The triglyceride level in blood samples of experimental animals fed with 400 gm/kg b.w. of CHSG decreased significantly to 93.5 mg/dl from 102.313 mg/dl in the toxic group. The cholesterol level decreased significantly from 181.39 gm/dl to 140.39 gm/dl in the group fed with 400 gm/kg b.w. of CHSG. The alkaline phosphatase level decreased from 90.65 U/L in toxic group to 64.52 U/L in the group fed with 400 gm/kg b.w. of EHS. The glucose level decreased significantly to 92.27 mg/dl in the group fed with 400 gm/kg b.w. of CHSG from 96.56 in the toxic group. Significant decrease was observed in the SGPT level of the group fed with 400 gm/kg b.w. of EHS which decreased to 51.18 U/L from 82.06 in toxic group. The SGOT level decreased significantly from 115.24 U/L in toxic group to 96.41 U/L in the group fed with 400 gm/kg b.w. of EHS. In vivo histopathological study on paracetamol induced changes in liver cured by *Simarouba glauca* leaf extracts was conducted. 42 male albino rats were sacrificed (7 groups, 6 rats each) by cervical dislocation and detail necropsy were performed. Representative tissue samples from

liver were collected and stored in formal saline solution for histopathological evaluation. The sections of liver in control group showed normal hepatocytes with pink staining cytoplasm and blue staining vesicular nucleus with characteristic hexagonal shape. The central veins were clearly visible and were normal. The hepatocytes were arranged in the cord like fashion showing characteristic hexagonal shape of the hepatic cells which were surrounding the central vein. The microscopic sections of liver of the toxic group showed moderate to severe degeneration of hepatocytes with a condensed pyknotic nucleus with distortion in the architecture in hepatic lobules. The hepatic cords were distorted. Formations of pseudo-lobules were also observed in this group. Blood vessels were severely congested. Necrotic changes were also observed and mild to moderate fibrous tissue proliferation were recorded. Infiltrations of mononuclear cells were another characteristic observation recorded in this group. The severity of the lesions increased towards the central part of the lobule. The degenerated hepatocytes showed granular eosinophilic cytoplasm. The histopathological study in the standard group revealed normal hepatic architecture of the hepatocyte. Mild congestion of blood vessels were observed in scattered area. Also mild degree of cellular swelling was observed in few hepatocytes. This might be indicative of progressive healing of liver damage induced by paracetamol toxicity. Microscopic sections of liver of the group fed with 200 mg CTSG showed congestion of blood vessels. No degenerative changes were observed. Mild to moderate haemorrhagic changes were also observed. The histopathological sections of liver of the group fed with 400 mg CHSG showed normal hepatic architecture with clear pink cytoplasm and blue stain nucleus. The hepatocytes were arranged in the cord like fashion showing characteristic hexagonal shape of the hepatic cells. No degenerative changes were observed. Blood vessels were congested with mild haemorrhages in the organs and no infiltrating cells were observed. In the group fed with 200 mg/kg body weight of ETSG, no hepato-cellular degenerative changes were observed in the hepatocytes during the microscopic study. The liver sections were showed presence of moderate to severe haemorrhages and congestion in the blood vessels. Severe congestion and haemorrhages were invariably seen in the microscopic section of liver of group fed with 400 mg/kg body weight of ETSG. Sinusoidal spaces were dilated. Hepatocytes were showed normal architecture with pink stained cytoplasm and blue staining nucleus. Therefore it is evident from the present study that leaves of *Simarouba glauca* had therapeutic and medicinal properties which would be beneficial in the cure of liver diseases.

## **Process standardization and shelf-life evaluation of Instant rice based meal**

*Lipika Chatterjee*

The present study entitled “Process standardization and shelf life evaluation of Instant rice based meal” was carried out with the objective to standardize the processing conditions of the ingredients of the developed instant rice based meal, to develop for the improvement of the formulation using different levels of the developed meal ingredients, to assess the reconstitution and organoleptic property of the best selected instant rice based meal and to evaluate the shelf life of the selected formulation using different packaging materials. The study was carried out in the Food Science laboratory of the Department of Food Science and Nutrition, Post Harvest Technology Laboratory of the Department of Horticulture, Nanotechnology Laboratory in the Department of Plant Pathology, Assam Agricultural University, Jorhat during 2016-2019. The raw materials were procured from the local market of Jorhat district and Horticulture farm, Assam Agricultural University, Jorhat. To develop the instant rice based meal formulations, precooked dehydrated ingredients were used. Initially a base meal (35% rice, 25% pulses, 20% vegetables, 5% RBO, 12% spices and condiments) was prepared by combining cereal, pulses, vegetables, spices and condiments and from the Base meal three formulations were developed and standardized viz., Formulation I (30% rice, 28% pulses, 24% vegetables, 5% RBO, 11% spices and condiments), Formulation II (30% rice, 29% pulses, 23% vegetables, 5% RBO, 11% spices and condiments) and Formulation III (30% rice, 30% pulses, 22% vegetables, 5% RBO, 11% spices and condiments) by changing the proportion of ingredients used in base meal and by incorporating other new ingredients. All the ingredients were individually processed by microwave cooking + blanching (MCB) and pressure cooking + blanching (PCB) and then dried at different temperatures. Nutrient analysis was done following the standard methods and acceptability trial was conducted using 9 point hedonic scale by semi-trained panelist. Process standardization for all the ingredients used in the formulation of instant rice based meal was done by trial and error method following the standard procedures. According to the acceptability score, it was found that Formulation III (PCB) had scored the highest score in terms of flavour (7.90±0.13), taste (8.00±0.07), texture (8.01±0.10) and overall acceptability (8.15±0.12) by the base meal (PCB) i.e.,

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7.78±0.12, 7.78±0.15, 7.70±0.11 and 7.90±0.09 for flavour, taste, texture and overall acceptability respectively. Formulation I (PCB) was judged with the score of 8.10±0.15 followed by Formulation II (PCB) i.e., 7.95±0.18 in terms of overall acceptability. Among the formulations processed by microwave cooking + blanching, Formulation III was judged best with the highest overall acceptability score of 8.26±0.20, followed by Formulation I (8.10±0.17), Base meal (8.05±0.19), and Formulation II (7.90±0.18). The results showed that highest acceptability was in Formulation III (MCB), whereas lowest acceptability was recorded in Formulation II (MCB). The instant meal prepared from pressure cooked + blanched (PCB) ingredients showed that the moisture content of Base meal, Formulation I, Formulation II and Formulation III and were not statistically different.

## **Formulation and characterisation of millet incorporated food products**

*Sushmita Khatoniar*

The present study was undertaken to formulate millet incorporated food products to utilize the inherent health benefits of millet grains. The ingredients used in the present study along with finger, foxtail and proso millet were wheat, buckwheat, Bengal gram, green gram, soybean and red kidney bean. The physico-chemical properties of the raw materials used were analysed. The bulk density of the raw ingredients used in the present study ranged from  $0.71 \pm 0.02$  to  $0.83 \pm 0.09$  g/ml respectively, with no significant difference between them at  $p \leq 0.05$  level. The water absorption capacity, oil absorption capacity, foaming capacity and foam stability were found highest in soybean flour among the raw ingredients used. The moisture content of the selected raw ingredients was ranged from  $7.24 \pm 0.05$  g/100g (soybean flour) to  $10.51 \pm 0.04$  g/100g (buckwheat flour). The protein content of the raw ingredients used was in the range of  $7.45 \pm 0.11$  g/100g (finger millet flour) to  $41.43 \pm 0.10$  g/100g (soybean flour). The crude fibre content was highest in red kidney bean flour ( $6.64 \pm 0.03$  g/100g) and lowest in Bengal gram flour ( $2.11 \pm 0.01$  g/100g). The carbohydrate content was found highest in wheat flour ( $70.88 \pm 0.24$  g/100g) followed by finger millet flour ( $68.23 \pm 0.23$  g/100g), buckwheat flour ( $66.72 \pm 0.11$  g/100g) and proso millet flour ( $66.58 \pm 0.45$  g/100g). Highest energy content was observed in soybean flour ( $425.92 \pm 0.63$  kcal/100g) followed by Bengal gram flour ( $369.86 \pm 0.67$  kcal/100g), proso millet flour ( $352.86 \pm 2.43$  kcal/100g) and also whole wheat flour ( $345.86 \pm 1.21$  kcal/100g). The total dietary fibre was highest in Bengal gram flour ( $21.46 \pm 0.20$  g/100g), followed by soybean flour ( $19.76 \pm 0.18$  g/100g) and red kidney bean flour ( $16.65 \pm 0.13$  g/100g). The ingredients used for preparation of multigrain mixes i.e., whole wheat flour, finger millet flour, foxtail millet flour, proso millet flour, buckwheat flour, Bengal gram flour, green gram flour, soybean flour and red kidney bean flour were added in three different ratios such as MM I (60:10:10:5:5:2.5:2.5:2.5:2.5), MM II (50:10:10:10:5:5:5:2.5:2.5) and MM III (40:10:10:10:10:5:5:5:5) and physico-chemically evaluated. Among the multigrain mix formulations, the functional properties such as water absorption capacity, oil absorption capacity, foaming capacity and foam stability were significantly higher in MM III than MM I and MM II. In case of

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proximate composition, the crude protein, crude fat, total minerals, crude fibre and total energy content was found highest in MM III formulation as  $14.42 \pm 0.11$  g/100g,  $3.23 \pm 0.03$  g/100g,  $2.44 \pm 0.04$  g/100g,  $4.01 \pm 0.06$  g/100g and  $352.60 \pm 2.14$  kcal/100g, respectively. Similarly, the minerals such as calcium, iron, phosphorous, zinc, sodium, potassium and magnesium were found highest in MM III formulation. While studying the starch fractions, MM III contained highest amount of resistant starch (18.67%). The in vitro protein digestibility was significantly higher in MM III whereas in vitro carbohydrate digestibility and Glycemic Index (GI) is lower in MM III than the other mixes which makes it superior in terms of health protective factors. Shelf life was studied using three different packaging materials such as LDPE (100 gauge), HDPE (200 gauge) and plastic bottle (Tarson) and analysed for moisture increment, free fatty acid, peroxide value and total plate count during storage. The HDPE pouch was found significantly better in preserving the flour than the other two packaging materials as moisture increment, free fatty acid, peroxide value and total plate count was found lowest after completion of storage period of 180 days. Value added products such as Indian flat bread (chapati), cookies, muffins, buns and pasta were prepared from MM I, MM II and MM III and sensory evaluation was carried out. The products prepared using MM III were found more acceptable in terms of sensory parameters such as flavor, texture, appearance, taste and overall acceptability. After analysing the nutritional parameters such as proximate composition, mineral contents and bioactive components of the developed products using MM I, MM II and MM III; the products prepared using MM III was found containing significantly higher amount of proximate constituents such as crude protein, crude fat, total minerals, crude fibre and total energy content. The mineral constituents such as calcium, iron, phosphorous, potassium, magnesium, sodium and zinc was also found highest in products prepared using MM III than MM I and MM II. As the MM III found superior in many aspects than the other multigrain mix formulations, it was selected for further in vivo study. In vivo study of the multigrain mix as compared to whole wheat flour revealed that Glycemic Index (GI) of MM III was 41 whereas GI of whole wheat flour was found 58. The mean blood glucose response of normal healthy rats after feeding MM III was found lowest (79.00 mg/100g) after 120 minutes of feeding. The supplementation of MM III on alloxan induced diabetic rats showed significant improvement in blood glucose level in both the experimental groups. The results of impact of supplementation of MM III on plasma lipid profile of experimental rats showed significant improvement in plasma high density lipoprotein (HDL) cholesterol, low density lipoprotein (LDL) cholesterol, total cholesterol, triglycerides, AST, ALP and ALT level after maintaining 28 days feeding period in comparison to the group feed with only high fat diet. On the basis of the present study, it can be concluded that the developed millet based multigrain mix has low glycemic index with functional efficacies in terms of hypoglycemic and hypolipidemic effect. The outcomes of the present study can be recommended for popularization and consumption of the mix and to create awareness related to health



benefits of such multigrain mixes to reach the vulnerable populations who are at risk of developing non-communicable diseases.

## **Efficacy trial of Instant Beverage Mixes developed using non dairy food ingredients: in vitro and in vivo studies**

*Vishakha Singh*

The present study entitled —Efficacy trial of Instant Beverage Mixes developed using non dairy food ingredients: in vitro and in vivo studies was undertaken to formulate Instant Beverage Mixes namely Cereal Based Instant Beverage Mix (CBIBM), Pulse Based Instant Beverage Mix (PBIBM), Vegetable Based Instant Beverage Mix (VBIBM) and Fruit Based Instant Beverage Mix (FBIBM). The product was developed using non dairy raw ingredients i.e. black rice (*Oryza sativa* L.), malted lentil (*Lens culinaris*), sweet potato (*Ipomoea batatas*) and mulberry (*Morus nigra*) through RSM approach using D optimal mixture design to optimize the formulations. The objectives of the present study were (i) Development of instant beverage mix using non dairy food ingredients (ii) Estimation of physicochemical characteristics, antioxidant and in vitro thrombolytic activity of the developed Instant Beverage Mixes (iii) Determination of in vivo efficacy in terms of hypoglycaemic and hepatoprotective property of the developed product using standard animal model protocols. The nutritional characteristics of the developed mixes were determined using standard procedures. The free radical scavenging activity was measured by DPPH method as outlined by Vani et al. (1997). Total phenol, flavonoids, alkaloids and carotenoids were determined following the methods outlined by Sharma et al. (2008), Aiyegororo and Okoh (2010), Mallick and Singh (1980), Anaya (1999), respectively. The water holding capacity of the Instant Beverage Mixes was determined by the method outlined by Sosulski et al. (1976), bulk and tapped density by the method outlined by Szulc and Lenart (2016), cohesiveness by the method outlined by Hausner (1967), flow property by the method outlined by Ribeiro (2020), Dispersibility by the method outlined by Shittu and Lawal (2007), Wettability by the method outlined by NIRO (1978), Hygroscopicity by the method outlined by Vivek et al. (2020), and colour was determined by the method outlined by Lamberts et al. (2006). Glycemic index was done according to the method outlined by Wolever and Jenkins (1987). The protein Efficacy Ratio was determined with the method outlined by Buamah et al. (1975). The

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thrombolytic property was determined by the method outlined by Hussain et al. (2014). For the hypoglycemic trial, supplementation was carried for a period of 21 days and blood glucose was determined using Coral Glucose estimating kit. For the Hypolipidemic and hypocholesterolemic effects of the developed Instant Beverage Mixes, supplementation was done for 28 days and estimation was done with the use of 7 standard commercial kits coral: HDL-D-160 ml, LDL-D-160 ml, Cholesterol 250 ml, Triglycerides 250 ml. Hepatoprotective effects of the developed Instant Beverage Mixes were assessed by using standard commercial kits coral: SGOT-160 ml, SGPT-160 ml. The shelf life was evaluated in terms of peroxide value (AOAC, 1975) and free fatty acid (AOAC, 1970) of the Instant Beverage Mixes over a time period of 60 days. Through Response Surface Methodology (D optimal Design) four formulations were optimized namely CBIBM (40:20:20:20), PBIBM (55:10:16:19), VBIBM (45:20:15:20), and FBIBM (35:25:15:25). These formulations were subjected to in vitro and in vivo efficacy trial. Results of proximate analysis of the raw ingredients revealed that, black rice, malted lentil, sweet potato and mulberry flour were rich in crude fibre, protein, crude fat, total mineral and total carbohydrate content. They were also rich in phytonutrients like total alkaloid, flavonoid, phenolic compound and carotenoid. The moisture content of the four formulations was within the permissible limit of >11 as per FSSAI recommendations. PBIBM had significantly higher ( $p>0.05$ ) crude protein ( $15.40\pm 0.24$  g/100g), crude fibre ( $11.74\pm 0.04$ g/100g) and total mineral ( $1.53\pm 0.12$  g/100g) content compared to other formulations. The carbohydrate content ( $80.51\pm 0.45$  g/100g) and energy value ( $358.55\pm 3.81$ kcal) was significantly higher ( $p>0.05$ ) in VBIBM. The total mineral content of PBIBM was significantly higher ( $p>0.01$ ) in comparison to other formulations. The iron, zinc, calcium, phosphorus, and magnesium content were  $7.80\pm 0.05$ mg/100g,  $3.30\pm 0.21$ ,  $56.12\pm 0.02$  mg/100g,  $180.53\pm 0.26$  mg/100g and  $249.33\pm 2.08$ , respectively. FBIBM had a significantly higher ( $p>0.05$ ) total alkaloid content of  $7.37\pm 0.30$  HE mg/100g and phenolic content of  $795.45\pm 1.22$  GAE mg/100ml. CBIBM had the highest flavonoid content of  $309.14\pm 1.35$  QE mg/100g and VBIBM had the highest carotenoid content of  $3.07\pm 0.35$  mg/100g. Free radical scavenging property of CBIBM, PBIBM, VBIBM and FBIBM was 63%, 77%, 51% and 56%, respectively. The highest water holding capacity of  $76.00 \pm 1.00\%$ , bulk density  $0.62\pm 0.01$ g/ml, and tapped density value of  $0.81\pm 0.01$ g/ml was observed in PBIBM followed by CBIBM, FBIBM and VBIBM. Better flow property of  $12.50\pm 0.50\%$  and poor cohesiveness of  $1.14\pm 0.04$  was observed in VBIBM. The highest dispersibility value of  $80.38\pm 1.58\%$  was observed in VBIBM. Highest hygroscopicity value of  $70.46\pm 1.42\%$ , and quick wet ability of  $46.91\pm 1.41$  sec. was observed in PBIBM. The Glycemic Index of CBIBM, PBIBM, VBIBM and FBIBM were 37.70, 35.10, 41.72 and 40.39, respectively. Supplementation studies revealed that, all the subgroups supplemented with test diets namely CBIBM, PBIBM, VBIBM, 8 FBIBM showed a significant decrease ( $p>0.05$ ) in blood glucose level. However, highest significant decrease ( $p>0.05$ ) was observed in D3 fed with 70% of PBIBM (from  $296.00\pm 29.30$  mg/dl to  $194.83\pm 26.55$  mg/dl). All four formulations namely CBIBM, PBIBM, VBIBM

and FBIBM had the ability to lower the triglyceride, cholesterol and LDL level. However, group D3 supplemented with 70% of PBIBM significant (p10 millimoles per kg fat as per FSAAI 2011 guidelines). The findings of this present study provide ample evidences and validate that the four Instant Beverage Mix (CBIBM, PBIBM, VBIBM and FBIBM) developed from non dairy foods are not only rich in terms of nutritional quality but significantly exerted hypoglycemic, hypolipidemic, hepatoprotective effects. It also substantiates that selection of the right foods for the formulation of ready to eat foods can manage and control the blood glucose and lipid profile, thereby exerting additional health benefits in management and prevention of non communicable diseases.

## **Job Satisfaction and Subjective Well being of adults**

*Ankita Dutta*

The present study entitled “Job satisfaction and Subjective well being of adults” was undertaken in Jorhat town area, Assam during 2017-2022. The objectives of the study were to determine the status of Subjective Well Being and Job Satisfaction of adults, to analyse the relationship between demographic variables and subjective well being as well as job satisfaction and to explore the impact of job satisfaction on subjective well being. A total of 384 adults aged 18 years and above working in various government and non government organizations (private) were selected for the study, using techniques of Cochran’s formula for infinite population, principle of saturation and maximum variation sampling. Follow-up explanations model of explanatory sequential design was adopted to conduct the present investigation. General information was collected from the respondents using a self developed questionnaire. Asha Job Satisfaction Scale was used to measure job satisfaction of the respondents in dimensions of salary and facilities, supervision, promotion, work opportunities and human relations. Satisfaction with Life Scale was used to determine the levels of life satisfaction among the respondents. Positive Affect and Negative Affect Scale – short form was used to find out the levels of positive affect and negative affect experienced by them. Lastly, a self developed Interview guide was used to conduct the qualitative interviews. Upon completion of data collection and analysis, the results indicated that job satisfaction and its dimensions explained 4.40% of the variability of SWB in the government employees and 48.20% of the variability of SWB in the private employees. Work opportunities, human relations and overall job satisfaction were found to be the best predictors of SWB in the government employees. Supervision, human relations and overall job satisfaction were the best predictors of SWB in the private employees. The demographic variables explained 68.50% of the variability of SWB of the total respondents. Demographic characteristics and work related variables namely age groups, marital status, family type, number of family members, parent’s educational qualification, respondent’s educational qualification, types of duties at work, expectation of working at the same place in future, participation in professional development activities, presence

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**Abstract of Ph.D. thesis**

**Department: Human Development and Family Studies**

**Major Adviser: Dr. Juri Baruah**

of dependent family members, supporting people around work, presence of any chronic diseases and working hours were found to be significantly contributing to the prediction of subjective well being of the respondents. The demographic characteristics explained 26.70% of the variability of Job satisfaction of the total respondents. Gender, working hours, participation in professional development activities, marital status, presence of dependent family members, respondent's educational qualification, years of work experience and presence of any chronic disease were found to be significantly contributing to the prediction of job satisfaction. Thematic analysis of the interviews revealed that work itself, work life balance and positive outlook can facilitate life satisfaction.

## **Behavioral outcomes and predictors of screen device usage by preschool children**

*Pooja*

In this modern time, screen devices have become an integral but essential part of everyone's daily life, young children especially preschoolers are unavoidably getting exposed to screen devices earlier in life and for longer hours. Research studies have provided evidence on the influence of screen device usage on different domains of children's development. The American Academy of Pediatrics (AAP) has recommended that children between the ages of 2-5 years should limit their screen time to a maximum of 1 hour per day under the supervision of parents. So considering the scenario, the present study was undertaken to investigate the —Behavioral outcomes and predictors of screen device usage by preschool children. The differential research design and correlational research design was adopted for the study. The sample of the study comprised of 300 children of age 2-5 years, randomly selected from the anganwadi centres and preschools of Roorkee and Bahadrabad blocks of Haridwar district, Uttarakhand. For the data collection, a general information schedule, self-structured screen related questionnaire, Child Behavioral Checklist for 1.5-5 years of children developed by Achenbach and Rescorla, 2000 and an Open-ended interview schedule were used. The data were analysed by using frequency-percentage, Chi-square test, student t-test, one-way ANOVA, Hierarchical linear regression, correlation coefficient and content analysis. The results revealed that all rural and urban preschoolers had an access to smartphones and televisions. Moreover, device-specific screen time and total screen time of urban children were higher as compared to rural children. The results of chi-square analysis and Independent t-test suggested that the child's age, gender, mother's education, mother's occupation, family income and mother's screen time were significantly associated with screen time of preschool children. Hierarchical linear regression analysis revealed that the mother's screen time was strongly predicting the screen time of rural and urban preschool children. Moreover, child's age, gender, mother's education, family type, family income and children's screen time were significantly associated with behavioral outcomes of children. The correlational analysis revealed significant and positive relationship of type of content of exposure (noneducational child - oriented programme and adult - oriented programme) with

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internalising and externalising among children. Content analysis of the mother's perception about preschoolers' screen device usage revealed that mother's expressed their concern about children's excessive indulgence with screen devices.



## **Effect of Parental Resilience on self esteem of adolescents**

*Rupjyoti Bhattacharjee*

Parental resilience is the ability to gainfully cope with and bounce back from all types of challenges. Parental psychological well being and self –efficacy, family functioning and social connectedness are playing an important role in parent’s ability to deliver high quality parenting. In addition to these factors, how parent accommodate adversity and find meaning to their everyday life is an important process to understand parental resilience, Payne and Denny et al. (2015). By analyzing all the key theories one point is cleared that resilience of an individual is influence by the protective factors at the individual level and familial levels and external to the family level. All the theorists were in a consensus that self esteem of an individual is influenced by the surrounding environment. Based on this background researcher attempts to examine the effect of parental resilience on self esteem of adolescent. 100 Adolescents ranging from 14-16 years of age studying in class IX & X from four government co educational schools located in two educational blocks and fulfilling all research criteria was included in the sample. Both the mother and father of selected respondents were included in the sample. Demographic information of both adolescents and parents sample were collected with the help of two sets of questionnaires prepared by the researcher to fulfill the research need. The self constructed scale of parental resilience was administered and for testing content validity the scale has been given to a panel of judges and internal consistency reliability was tested by conducting a pilot study with non sample respondent. Data were tested statistically by Cronbach alfa reliability test and a significant value .756 was found. State self esteem scale developed by Heatherton and Polivy (1991) was used to assess the self esteem. To test the reliability of the State self esteem scale in socio-cultural context of Jorhat district of Assam, a pilot study was conducted on 30% non sample respondents and the value of Cronbach's Alpha coefficient was .615. Result of the study revealed that demographic characteristics like education, occupation and income showed significant association with parental resilience. In the hierarchical pattern of importance, the aspect of seeking help at the time of need has been identified as most important aspect by the parents. Majority of the fathers and mothers were

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possessing average level of resilience. Significant differences exist between mother and father in parental resilience. Significant positive correlation was found between resilience of mother and father. Highest percentage of adolescents possesses average range of self esteem. Statistically significant difference has been seen between self esteem of boys and girls. Significant differences in self esteem exist among adolescents of different performance level namely high, medium, and low in academic as well as co-curricular activities. Resilient approaches of fathers and mothers throughout the journey of parenthood found to have a positive relationship with self esteem of adolescents. Two aspects of parental resilience namely problem solving and positive attitude have prominent positive effect on self esteem of adolescents, so based on the scores of these two aspects of parental resilience, the self esteem score of the adolescent can be predicted for a new adolescent sample.

# **Effect of Spiritual Education on Moral Values and Psychological Well-Being of Youth**

*Sendi Seb Rengma*

Moral values seem deteriorating drastically among the youth. They youth face adversities of life and tend to develop anti social behaviour which affects their psychological well-being. Spiritual education will help the youth to cope with the adversities and lead a meaningful life. Hence, the present study was undertaken to determine the effect of spiritual education on moral values and psychological well-being and to find out the relationship between moral values and psychological well-being of youth. A total of 400 youth were selected for the study. Two hundred youth (100 from Majuli and 100 from Barpeta) attending a general degree course and exposed to spiritual education and another two hundred youth (100 from Jorhat and 100 from Kamrup metro) attending a degree course in a general college and not exposed to any institutional spiritual education were considered. To make the group homogeneous, the respondents from the age group of 20-23 studying in Bachelor level (2nd year and 3rd year) were considered as the sample of the study. A self structured interview schedule on moral values and standardized scale namely "Ryff Psychological well-being scale" (1989) was used for data collection. The findings of the study revealed that the youth with spiritual education had higher level of moral values and psychological well-being than those without spiritual education. It was also found that the youth with spiritual education hold all the seven moral values (respect, self-discipline, compassion, generosity, forgiveness, humility, and justice) more deeply and strongly than the youth without spiritual education. The findings also showed that the correlations among moral values were higher in case of youth with spiritual education than those without spiritual education. A highly significant and positive correlation was found between moral values and psychological well-being of both respondents with spiritual education and without spiritual education. Though there was a highly significant and positive correlation between moral values and psychological well-being of both the groups of respondents, the relationship was stronger in the youth with spiritual education ( $r=0.79$ ) than those without spiritual education ( $r=0.50$ ). The findings also revealed that more number of moral values had significant and positive contribution towards all the six dimensions of psychological well-being of youth with spiritual education than those without spiritual education.

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**Abstract of Ph.D. thesis**

**Department: Human Development and Family Studies**

**Major Adviser: Dr. Jinamoni Saikia**

## **Removal of residual textile dye effluent using activated carbon prepared from agricultural residues**

*Reena Roy*

Textile dyeing industries are one of the most polluted industries which create lots of problems for environmental pollution. The textile dyeing industry produces in large amount of production and release of waste water effluent. In the present study, activated carbons were prepared from almond, coconut, mustard, rice bran and sesame oil cakes. The powdered oil cakes were treated with 5% NaCl for 12 hours in the rotary shaker followed by chemical activation with 1 N H<sub>3</sub>PO<sub>4</sub>, 2.5 N H<sub>2</sub>SO<sub>4</sub> and 2.5 N H<sub>3</sub>PO<sub>4</sub> for 24 hours. The pyrolysis was performed at 300°C for 2 hours. The ball milling technique was applied to reduce the particle size of the activated carbon. The integrated activated carbons were used for the color removal for acid and metal complex dye effluent from the wool dyeing unit. For dye effluent treatment different concentrations of adsorbent viz., 0.1%, 0.25%, 0.5% and 1.0% and time period 30, 60 and 90 minutes were taken respectively. The results showed that very small quantities (1.0 and 2.0%) of activated carbons were sufficient to remove around 92% color from the dye effluent. The particle size of the activated carbon was further reduced by ball milling in Pulverisette 6 for 1 hour. The characterization of activated carbon was synthesized such as FTIR, SEM, EDX, XRD, BET, bulk density, porosity, ash content, moisture content, pH, zero point charge (pzc), iodine number, methylene blue, particle size analysis, COD and BOD respectively. The activated carbon characterized by using scanning electron microscopy (SEM) revealed the small pore size with higher surface area that indicates lower absorbency. FTIR analysis also revealed the presence of various types of functional groups during different activation temperatures. From EDX analysis, a negligible quantity of Na, K and S in 2.5 N H<sub>3</sub>PO<sub>4</sub> almond activated carbons and in 2.5 N H<sub>2</sub>SO<sub>4</sub> almond activated carbons there was a negligible quantity of Mg, Si, P and C and other elements were present. The X-ray diffraction pattern of the 2.5 N H<sub>2</sub>SO<sub>4</sub> and 2.5 N H<sub>3</sub>PO<sub>4</sub> almond were recorded at peak 25° and 29° respectively, and indicated the presence of amorphous structure of the activated carbon with the diffraction pattern of (002). In BET analysis; the surface area, pore radius and pore

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**Abstract of Ph.D. thesis**

**Department: Textiles and Apparel Designing**

**Major Adviser: Dr. Ava Rani Phukan**

volume of 2.5 N H<sub>3</sub>PO<sub>4</sub> was recorded as 16.14m<sup>2</sup> /g, 0.85nm and 0.029cc/g and in 2.5 N H<sub>2</sub>SO<sub>4</sub> almond, it was 7 recorded 64.28m<sup>2</sup> /g, 0.72nm and 0.040cc/g respectively. Bulk density 4.533g/cm<sup>3</sup> , porosity 4.500%, ash content 0.176%, moisture contents 0.040%, methylene blue 123.667mg/g, pH 6.180, zero point charge 4.140pzc, particle size 310.333nm, iodine number 22.067m<sup>2</sup> /g of 2.5 N H<sub>3</sub>PO<sub>4</sub> almond (ball milling) activated carbon were recorded best compared to 1 N H<sub>3</sub>PO<sub>4</sub> coconut (ball milling) and 2.5 N H<sub>3</sub>PO<sub>4</sub> mustard (ball milling) activated carbon. The bulk density 5.233g/cm, porosity 3.633%, ash content 0.172%, moisture contents 0.071%, methylene blue 116.000mg/g, pH 6.973, zero point charge 6.460pzc, particle size 825.000nm, and iodine number 21.5333m<sup>2</sup> /g were also recorded best in 2.5 N H<sub>2</sub>SO<sub>4</sub> almond (ball milling) activated carbon metal complex dye effluent compared to 2.5 N H<sub>3</sub>PO<sub>4</sub> rice bran (ball milling) and 2.5 N H<sub>2</sub>SO<sub>4</sub> sesame (ball milling) activated carbon. The good absorbency was recorded 0.107 at 2.0% concentration and 90 minutes of contact time in 2.5 N H<sub>3</sub>PO<sub>4</sub> almond (ball milling) activated carbon acid dye effluent compared to 1 N H<sub>3</sub>PO<sub>4</sub> coconut (ball milling) and 2.5 N H<sub>3</sub>PO<sub>4</sub> mustard (ball milling) activated carbon. The pH and TDS of the effluent were recorded 4.523 and 2668.66mg/L, concentration 2.0% in 60 minutes, which were found to be best among the 1 N H<sub>3</sub>PO<sub>4</sub> coconut (ball milling) and 2.5 N H<sub>3</sub>PO<sub>4</sub> mustard (ball milling) activated carbon in acid dye effluent. The good absorbency was recorded 0.153 concentration 1.0% and 90 minutes of contact time in 2.5 N H<sub>2</sub>SO<sub>4</sub> almond (ball milling) activated carbon metal complex dye effluent compared to 2.5 N H<sub>3</sub>PO<sub>4</sub> rice bran (ball milling) and 2.5 N H<sub>2</sub>SO<sub>4</sub>sesame (ball milling) activated carbon. The pH and TDS of the effluent were recorded best in 5.233 and 2219.33mg/L, concentration 1.0% at 90 and 30 minutes respectively in 2.5 N H<sub>2</sub>SO<sub>4</sub> almond (ball milling) activated carbon metal complex dye effluent. Therefore, 2.5 N H<sub>3</sub>PO<sub>4</sub> almond (ball milling) activated carbon acid dye and 2.5 N H<sub>2</sub>SO<sub>4</sub> almond (ball milling) activated carbon metal complex dye effluent proved to be an excellent oil cake for preparation of activated carbon in the textile dye industry and can be used as an alternative source for wastewater treatment.

## **Coating mulberry (*Bombyx mori*) silk fabric with fibroin based nanoparticles**

*Saradi Jyotsna Gogoi*

Textile industries in 21st century was experiencing the benefits of nanotechnology in multiple fields of application. Nanotechnology overcame the limitation of traditional process and technology by incorporating many functional properties such as fabric softness, durability, breathability, antimicrobial, water repellency, fire retardancy, ultra violet protection properties etc., to the textile world. It dealt with those properties of materials which could change incredibly when the particle size of the material had fall below approximately 100nm. Application of conventional method to the fibre, yarn or fabric would lose their function and comfort gradually while wearing or laundering. But imparting of nanotechnology to fibre, yarn or fabric would provide resistance to functional properties because, nano particles have large surface area to volume ratio and high surface energy. Coating of mulberry silk fabric with fibroin based nanoparticles would help in protecting skin as well as the mulberry silk fabric from the harmful UV rays. Further the life of fibroin coated mulberry silk might increase due to UV protection. Therefore, an attempt had been made to coat mulberry silk fabric with fibroin based nanoparticles from muga silk. The present research work was carried out on, —Coating mulberry (*Bombyx mori*) silk fabric with fibroin based nanoparticles! With the following objectives: 1. To coat mulberry silk fabric with fibroin based muga nano particles. 2. To expose the fibroin coated mulberry silk fabric in UV light chamber. 3. To assess the properties of mulberry silk fabric before and after fibroin nano coating. Two sources for coating mulberry silk fabric namely fibroin from muga silk and zinc oxide were selected for the study. Synthesis of fibroin nanoparticles, coating method, fibroin concentration and zinc oxide concentration were optimized. During coating in all the processes material to liquor ratio (1:20) was kept constant. Coating method, fibroin concentration and zinc oxide concentration were optimized, based on the UPF value obtained from the test sample before and after coating. The coated mulberry silk fabric with fibroin and fibroin + zinc oxide indicated very good protection against UV radiation with UPF value 50.78 and 77.19, respectively. The other important properties of coated samples were also very 8 satisfactory. The properties like tensile strength, air permeability, wicking height, stiffness, thickness,

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**Abstract of Ph.D. thesis**

**Department: Textiles and Apparel Designing**

**Major Adviser: Dr. Bulbul Baruah**

crease recovery angle of coated samples decreased due to coating, which was negligible. For example, the tensile strength of controlled sample was 22.28 kgf and 34.60 kgf in warp and weft respectively whereas only fibroin coated sample increased its strength 7.02% in warp direction and 15.58% in weft direction. But the fibroin + zinc oxide coated sample showed decreased strength in warp direction (13.20 kgf) and increased strength in weft direction (53.60 kgf). Air permeability was related to comfort property of fabric. In the present investigation air permeability of controlled sample is 0.102 KPaS/m where as fibroin coated fabric showed 0.094 KPaS/m and fibroin + zinc oxide coated fabric showed 0.073 KPaS/m. It could be confirmed that, these nano particles coating did not affect the comfort property of the fabric. Besides these, wash durability of coated fabric was also found to be good. Fibroin coated samples could resist UPF up to 10 washings and fibroin + zinc oxide coated silk fabric could resist UPF up to 15 washings. Hence, from the study it was found that, fibroin and fibroin + zinc oxide could be effectively used for coating mulberry silk fabric. It protected the mulberry silk fabric as well as our skin from the harmful ultraviolet radiation.

## **Master of Science (Agriculture)**

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- **Agricultural Biochemistry**
- **Agriculture Biotechnology**
- **Agricultural Economics and Farm Management**
  - **Agronomy**
  - **Agrometeorology**
  - **Crop Physiology**
    - **Entomology**
  - **Extension Education**
    - **Horticulture**
    - **Nematology**
- **Plant Breeding and Genetics**
  - **Plant Pathology**
    - **Sericulture**
    - **Soil Science**
- **Tea Husbandry and Technology**



## **Starch digestibility and estimated glycemic index of rice differing in amylose contents**

*Deena Lyrisha Aranha*

Rice (*Oryza sativa* L.) is the most important cereal crop worldwide and serves as the major energy source in human nutrition. Starch digestion rate is an important consideration for rice consumers, particularly for diabetics. In the present study, eleven rice varieties differing in amylose contents were assessed for their variation in starch digestibility. An in vitro enzymatic starch digestion method was applied to estimate the glycemic index of rice varieties based on the kinetics of starch hydrolysis. Moisture content in the studied varieties ranged from 11.2% to 13.56%, reducing sugars from 0.33 to 0.65g/100g and starch content from 62.33 to 88.17%, with amylose content from 1.6% to 24.34% and amylopectin content from 75.65 to 98.39% on a dry weight basis. In vitro starch digestion resulted in readily available glucose (RAG) content from 44.96 to 95.4% and free glucose (FG) from 0.102 to 0.211%. The digestible and available starch fractions were calculated. Rapidly digestible starch (RDS) ranged from 40.33 to 85.72% and slowly digestible starch (SDS) from 2.59 to 41.99%. The resistant starch (RS) varied between 6.09% and 20.01%. The kinetics of in vitro starch digestion was determined and used for the calculation of hydrolysis index (HI) with which the glycemic index (eGI) was finally estimated. Starch digestibility and eGI varied widely among the rice varieties. The hydrolysis index ranged from 35.88 to 90.25 and with the lowest HI value of 35.88, Gitesh had the lowest eGI of 59.41, followed by Bahadur and Ranjit with eGI of 62.79 and 63.27 respectively. All these three varieties along with Prafulla, Numali, and TTB Black rice were found to be medium glycemic index rice. Sam Chakuwa, Lahi Chakuwa, Betguti, Joha Bora, and Ronga Bora were the high glycemic index rice.

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**Abstract of M.Sc. thesis**

**Department: Agricultural Biochemistry**

**Major Adviser: Dr. S. Baishya**

## **Alternative use of waste of tea gardens as potential source of biomolecules and biochar**

*Naina Goswami*

In the present study, factory tea waste and garden tea waste (pruned leaf) were collected from Cinnamara Tea Estate, Jorhat and tea garden of Assam Agricultural University, Jorhat for production of biochar and to extract crude TRIA and to know their properties and effects on plant growth, respectively. Garden tea waste (pruned leaf) was used for extraction of crude n-triacontanol (TRIA) using conventional Soxhlet extraction method. Yield of crude TRIA was 4.45%, on dry weight basis. The potential of crude n-triacontanol as a plant growth regulator for brinjal plant was explored and compared with the commercial TRIA (Miraculan). In terms of plant height, flower count, leaf count, chlorophyll content and mineral content (N%, P%, K%) of leaves, crude n-triacontanol extract (petroleum ether extract) showed better results than the control (distilled water). Factory tea waste was used for the production of biochar using pyrolysis. Biochar was produced by two methods using charring device (Method 1) and muffle furnace (Method 2). The yield of biochar was from 71.07% to 77.21%. There were significant differences among the biochar prepared by the two methods regarding the physical and chemical properties. It was observed that the percent moisture content, bulk density, apparent water holding capacity of biochar prepared from charring device (Method 1) was 6.1%, 0.19 g/cm<sup>3</sup>, 80.17%, respectively and from the muffle furnace (Method 2) was 3.34%, 0.21 g/cm<sup>3</sup>, 84.67%, respectively. Additionally, chemical properties like percent total carbon content, nitrogen content, phosphorus content, potassium content, cation exchange capacity, crude fibre and pH for method 1 was 50.9%, 3.94%, 0.0377%, 0.071%, 11.87 cmole/kg, 1.63% and 7.88 respectively and for the method 2 was 60.24%, 4.54%, 0.0441%, 0.073%, 15.77 cmole/kg, 1.13% and 7.9, respectively. The present study revealed that the waste leaves from the pruned branches possess plant growth promoting properties, which may be commercially exploited in the form of crude extract. Production of biochar using factory tea waste may also be a good option for carbon sequestration and also for soil application for crop growth.

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**Abstract of M.Sc. thesis**

**Department: Agricultural Biochemistry**

**Major Adviser: Dr. Priyanka Das**

## **Study on nutritional and antioxidants profile of some specialty rice cultivars of Odisha**

*Rajesh Bal*

Odisha has been considered as the center of genetic diversity for cultivated rice and is endowed with numerous cultivars of specialty rice which have great market potentiality. These traditionally cultivated cultivars were rich in nutritional and healthpromoting components. However, these cultivars were on the verge of disappearing because farmers were shifting to high-yielding types, which had great market potential and provide them with financial security. There is dearth of information on the nutritional aspect of these traditional unexplored rice cultivars. The present investigation entitled 'Study on the nutritional and antioxidant profiles of several specialty rice cultivars from Odisha' was carried out in the laboratory of Department of Biochemistry & Agricultural Chemistry, Assam Agricultural University, Jorhat. The objective of this study was to assess the nutritional value and antioxidant activity of these specialty rice cultivars from Odisha. A total of eleven cultivars was used in the study, out of which eight were aromatic (Rajendra Bhagabati, Nua-Dhusara, Kalajeera, Nua-Kalajeera, Nua-Chinikamini, Lall Basana, NuaPurnabhog and, Nilabati) two were pigmented rice (black rice Kalabati and red rice Jaghabalia), and one as a check variety (Kalachampa). The moisture content, reducing sugar, total soluble sugar, starch, total carbohydrate, crude protein, soluble protein, crude fat, crude fibre, ash, total phenolics, total anthocyanin, and total antioxidant activity of the cultivars were determined. The cultivars were collected from the farmer's field at different places of Odisha as well as from National Rice Research Institute, Cuttack, Odisha. The results showed that the moisture content of all the cultivars were lower than the check variety Kalachampa which recorded  $11.914 \pm 0.08$  % on a fresh weight basis. The highest per cent starch content was recorded in Nua-Kalajeera ( $82.791 \pm 0.96$ ) followed by Kalajeera ( $80.605 \pm 1.173$ ) and Kalabati ( $79.896 \pm 0.176$ ) while lowest in Nua-Purnabhog ( $59.612 \pm 0.328$ ). Cultivars varied significantly with respect to starch content ( $CD_{0.05}=3.407$ ). The highest starch content was observed in aromatic rice cultivar Nua-Kalajeera ( $82.7g\%$  DW) followed by Kalajeera ( $80.6 g\%$  DW) and Kalabati ( $79.89 g\%$  DW) and the least recorded in Nua-Purnabhog ( $59.6 g\%$  DW). Per cent crude protein content varied

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**Abstract of M.Sc. thesis**

**Department: Agricultural Biochemistry**

**Major Adviser: Dr. R. Kandali**

significantly ( $CD_{0.05}=0.494$ ) and was recorded highest 7 in Nua-Dhusara ( $10.384\pm 0.294$ ) followed by Nua-Purnabhog ( $9.384\pm 0.147$ ) and Kalabati ( $8.552\pm 0.147$ ). Per cent crude fibre content was found highest in Kalabati ( $0.984\pm 0.073$ ). Cultivars differ significantly ( $CD_{0.05}=0.239$ ) with respect to their ash content with the highest recorded in Nua-Kalajeera ( $2.423\pm 0.041$ ). The highest total phenol content (g GAE/100gm) was recorded in Jaghabalia ( $0.833\pm 0.014$ ) followed by Kalabati ( $0.701\pm 0.001$ ). On the other hand, the variation seen in total anthocyanin content among the cultivars was significant. The highest anthocyanin content was in black pigmented rice cultivar Kalabati ( $5.016$  mg Cya-3-gluE /100g FW) followed by aromatic rice Nua Kalajeera ( $1.204$  mg Cya-3-gluE /100gm) and Kalajeera ( $1.132$  mg Cya-3-gluE /100gm FW). The least was recorded in Lall Basana ( $0.310$  mg Cya-3- gluE/100gm FW). The antioxidant activity measured as per cent DPPH free radical scavenging activity was highest in Jaghabalia ( $55.324\pm 0.352$ ) followed by Kalabati ( $48.576\pm 2.876$ ). The high antioxidant activity of the cultivar Kalabati might be due to high anthocyanin and total phenol content. The selected pigmented and scented specialty rice cultivars were found to be superior to high-yielding variety Kalachampa in different nutritional parameters in the grain such as carbohydrates, Crude protein, crude fiber, Crude fat, total phenolic content, total anthocyanin, and antioxidant activity. Nua-Purnabhog, with a low starch content of 59.61 g percent DW, might be a lowstarch dietary option. It will make it easier for persons with hyperglycemia or diabetes to eat low-starch cereals. From the results of the present investigation, it could be concluded that the black rice cultivar Kalabati appeared to be a promising cultivar with a superior nutritional composition and antioxidant activity and thus has a great market potentiality.

## **Studies on profile of phenolic compounds in a few pigmented rice varieties of Assam**

*Surbhi Sahewalla*

Considering the growing economic importance together with health benefits of pigmented rice, the present research work —Studies on profile of phenolic compounds in a few pigmented rice varieties of Assam was carried out. In the present study, fourteen rice varieties were considered which included eleven traditional varieties and two recent varieties developed at AAU. The results were compared with the well known traditional pigmented rice variety from Manipur, Poreiton Chakhao. There was significant difference among the varieties regarding content of different phenolic compounds. The total phenol content (TPC) ranged from 493.611 mg GAE/100g (TTB Black Rice, AAU 1347-2, line 11) to 37.101 mg GAE/100g (Amona Bao). The total flavonoid content (TFC) ranged from 151.667 mg QE/100g (TTB Black Rice, AAU 1347-2, line 11) to 53.316 mg QE/ 100g (Amona Bao). The total anthocyanin content (TAC) ranged from 13.904 mg cyanidin-3- chloride equivalent (TTB Black Rice, AAU 1347-2, line 11) to 1.006 mg cyanidin-3- chloride equivalent (Dol Bao). The amount of rice showing 50% DPPH free radical scavenging activity (IC 50 value) ranged from 6.610 mg (TTB Black Rice, AAU 1347-2, line 11) to 29.376 mg (Amona Bao). The traditional rice varieties of Assam, specially Betu, showed antioxidant activity equivalent to Chakhao-1. The HPLC analysis revealed presence of both cyanidin-3-glucoside and peonidin-3-glucoside in the black pigmented rice varieties viz. TTB Black Rice (AAU 1491-4, line 7), Chakhao-1, Chakhao-2 and TTB Black Rice (AAU 1347-2, line 11). However in the red rice varieties analysed (Balam and Nepali Chakuwa), these two anthocyanins were not detected. The present study revealed both the varieties developed at TTB Black Rice (AAU 1491-4, line 7) and TTB Black Rice (AAU 1347-2, line 11) showed promising result regarding content of phenolic compounds including anthocyanin and antioxidant activity.

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**Abstract of M.Sc. thesis**

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**Major Adviser: Dr. Priyanka Das**

## **A study on the prospect of microbe-mediated enhancement of anaerobic germination in few popular rice cultivars of North-East India**

*Amrita Churaman*

Rice (*Oryza sativa* L.; family: Gramineae) is the predominant cereal crop and its cultivation is the backbone of the economy of several countries including India. The crop is traditionally established by raising seedlings in seed beds followed by transplanting them into the main field. The Direct Seeded Rice (DSR), promoted as a means of sowing to manage the time and labor-intensive system of traditional transplantation, is constrained by low crop establishment due to recurrent floods during the sowing season since the rice seeds are sensitive to low oxygen stress during germination. Pre-treatment of hypoxia-susceptible rice cultivars with efficient plant growth-promoting rhizobacteria can enhance germination under flooded condition and provide a solution to recurrent flood-induced crop damage. In this study, one hundred and twenty-six popular rice varieties of the NE region were screened for hypoxia germination and categorized as susceptible (82), intermediate (26) and tolerant (18) varieties. Cultivars positive for hypoxia showed germination percent of  $\geq 80\%$  and coleoptile length of  $\geq 8.5\text{cm}$ . Further, forty bacterial isolates from a core microbial collection were screened for hypoxia germination promoting traits following a series of biochemical and molecular analyses; and the most efficient isolates were evaluated for their growth promoting efficacy in the different categories of rice cultivars through seed biopriming. As compared to the untreated controls, the bio-primed rice seeds with the efficient isolate ABT\_AC37 (*Bacillus altitudinis*) revealed a significant ( $p < 0.05$ ) increase in the germination percentage (at least by 40%) and mean coleoptile length (~25%) in all the categorical representative varieties. Biochemical analysis showed significantly higher amylase and trehalase activity in the treated varieties which were in congruence with the Quantitative Real-Time PCR (qRT-PCR) data revealing increased transcript levels for ADHI, RAm3D and CIPK15 gene in the treated varieties as compared to the untreated varieties for day 3 and day 5 post-germination. Principal component analysis (PCA) indicated the bio-primed plants with elevated levels of stress-responsive metabolites such as LysoPE 18:0, Aspe Aspe, Tryptophan, MAG (18:3),

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Gibberellin, Acetic acid etc. Biopriming of hypoxia-sensitive landraces with the PGPB, *B. altitudinis* can enhance their survival rate under flooded conditions. Validation of the findings of this study at the Field level can encourage the adoption of DSR.

## **Expression profiling of pathogenesis related (PR) genes in response to *Pseudocercospora eumusae* infection in Banana (*Musa* spp.)**

*Kumar Nupur Hrishikeshan*

Eumusae leaf spot disease caused by *Pseudocercospora eumusae* is an economically important disease of banana (*Musa* spp.). The disease has a significant impact in India's key banana growing areas, including the North Eastern regions. Eumusae leaf spot causes a significant reduction in yield, particularly in the Cavendish subgroup of cultivars. The disease is very destructive if left uncontrolled and its management is highly dependent on the use of chemical fungicides. Plants activate number of pathogenesis related (PR) genes upon infection by pathogens which encode proteins involved in host plant resistance. PR proteins are low molecular weight, acid soluble, protease resistant proteins which function in the form of enzymes, receptors and structural proteins. These proteins are grouped into 17 different classes according to their functions. In the present study, a differential profiling of gene expression patterns of PR genes was conducted between banana cultivars resistant and susceptible to the pathogen, in order to elucidate the important PR genes implicated in response to defense against this serious disease. The banana cultivars, Simolu Monuhar and Sapor Jahaji, were selected for the present investigation, which have been reported to be resistant and susceptible to Eumusae leaf spot respectively. Pathogenicity assays were conducted using pure culture of *P. eumusae* through artificial inoculation of the plants. In the susceptible cultivar, the intensity of infection was severe and the disease progression was very fast. The symptoms were first observed by the 7<sup>th</sup> day of infection as small, linear, light brown streaks which gradually increased in size and turned into grayish lesions with dark brown borders, by the 20th day of infection. On the other hand, in the resistant cultivar Simolu Monuhar, symptom development was slower and less intense. The symptoms were observed after about 18 days of infection. Moreover, the disease progression was restricted by 40 to 45 days of infection as the necrotic lesions did not grow any further. For semi-quantitative RT-PCR analysis, leaf samples were collected from plants artificially inoculated with *P. eumusae* as well as uninoculated plants (water treated control) at 48 and 96 hpi (hours post inoculation) for RNA extraction and cDNA

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synthesis. Five PR genes namely PR1, Chitinase, PR4, Germin-like protein and Thaumatin-like protein were selected for differential expression profiling among the resistant and susceptible cultivars. The expression analysis revealed that, all the PR genes were highly upregulated after infection in Simolu Monuhar and the expression levels remained high across both the time points as compared to those in controls. On the other hand, in Sapor Jahaji, the expression levels of the genes were very low as compared to those in case of Simolu Monuhar, even after infection by the pathogen. Thus, all the PR genes are clearly implicated to have a possible role in active defense responses in the resistant cultivar, contributing towards resistance against the pathogen *P. eumusae*.

## **Study on drought responsive miRNA and its interaction with target mRNA in rice**

*Monika Jain*

Rice being a semi-aquatic crop is highly susceptible to drought, with its yield being severely impaired. Indigenous germplasm of any species naturally have adaptation mechanism to environmental adversities. The regulatory mechanism behind the differential expression of genes implicated under drought tolerance are yet to be touched by extensive studies. Micro-RNAs (miRNAs) are a class of small, non-coding, regulatory RNAs that are known to regulate gene. ARC-10372, a drought-tolerant, traditional rice cultivar of NorthEast India was the experimental plant of the current study. Previous study on ARC-10372 carried out in the department have identified and validated many known and novel drought-responsive miRNAs (Singh et al., 2020), suggesting that they might be a key player in providing tolerance. But role of a given miRNA on plant's biology is only determined by its valid mRNA target. So in the current study, 6 novel and 4 known drought-responsive miRNAs were chosen from the work, whose relative expression levels have also been reported (Singh et al., 2020). Targets for the same were predicted and characterized using bioinformatics tool psRNATarget and the ones that could be implicated under drought were selected for further validation. The targets were quantified by qPCR from leaf tissues at two conditions- Control and Stress for both the vegetative and reproductive stage to first confirm the differential expression of these targets under drought at both the stages, so that they can be considered as drought-responsive. Thereafter, the relative expression levels of target obtained under stress condition was compared with the expression levels of their miRNA under same stress. A negative correlation between them might establish the correctness of the predicted target. Same was observed for 5 miRNA (viz., miR23, miR14, miR166, miR1861, miR3982) out of 8 selected. Hence, they might be considered valid and some of them coded for Transcription Factors (TFs) like leucine zipper and ZSWIM TFs. The drought-responsive miRNAs or their targets can be a good focus for improving drought-tolerance of crops in near future.

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**Major Adviser: Dr. Priyabrata Sen**

## **Hormonal regulation of defense gene expression against *Alternaria brassicicola* infection in *Brassica rapa***

*Mritisha Bhattacharjee*

*Alternaria* blight caused by *Alternaria brassicicola* is an economically important disease of rapeseed-mustard. Every year, *Alternaria* blight infection leads to yield losses up to 35- 46% all over the world and its management is highly dependent on fungicides. Key modulators to a plant's defense are some signaling molecules like jasmonic acid (JA) and salicylic acid (SA), which have been found to have a major role in initiating host responses to stresses. Reportedly, upon pathogen attack, plants activate a number of defense response genes, which encode proteins implicated in host plant resistance. Identifying resistance related genes and elucidating hormonal regulation of defense mechanisms and associated pathways would not only contribute towards understanding the pathosystem, but also aid in the development of disease resistant/tolerant cultivars. With this rationale, we carried out expression profiling of selected defense related genes (chitinase,  $\beta$ -1,3-glucanase, PR5,  $\beta$ - glucosidase, NBLRR, LRR-RK) in *B. rapa* in response to exogenous MeJA treatment, in order to investigate how defense genes are modulated upon the treatment and elucidate if JA signaling pathway is responsible for activation of the genes. qPCR analysis was carried out on *B. rapa* cDNA samples (treated with MeJA and water treated control) at 24 hpt and 48 hpt. The expression analysis revealed that, exogenous application of MeJA results in fast induction of defense response genes like chitinase and  $\beta$ -glucosidase in *B. rapa*, within 24 hpt. Interestingly, upon MeJA administration, transcript levels of PR5 and NB-LRR were observed to be decreased after the treatment. Moreover, no significant changes in expression was observed in case of  $\beta$ -1,3-glucanase and LRR-RK genes upon MeJA treatment. Hence, it can be concluded that, while jasmonic acid has a major role to play in regulating the activation of chitinase and  $\beta$ -glucosidase, it may not be involved in the regulation of  $\beta$ -1,3-glucanase and LRR-RK since no significant changes in expression was observed. Furthermore, significantly reduced levels of PR5 and NB-LRR immediately after MeJA treatment indicate a possible involvement of cross-talk with other endogenous signaling pathways in the host plant.

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# Investigation on the Effect of Few Indigenous Medicinal Plants on Stress Response of *Caenorhabditis Elegans*

*Namrata Farwaha*

The ever-increasing popularity of herbal supplements modulating aging has shifted focus towards development of natural therapeutics for curing age related diseases in living organisms. The progression in age is correlated with general elevation in oxidative stress; the increment in oxidative stress ultimately affects human health. This led to search for novel herbal compounds counteracting oxidative and other stresses. In this study, the effect of extracts of three indigenous medicinal plants, viz., *Ocimum sanctum*, *Euphorbia hirta* and *Terminalia chebula* were evaluated on *Caenorhabditis elegans*. The study delineates the effect of various concentrations of the above herbal extracts on the overall lifespan using survival as well as stress-response assays. The maximum lifespan extension was observed in *T. chebula* extracts (14.7%;  $P < 0.05$ ) followed by *O. sanctum* (4.01%;  $P < 0.05$ ); however, no effect had been seen in case of *E. hirta* ( $P > 0.05$ ). Furthermore, all the three extracts were able to modulate the oxidative stress in vivo but none of them could significantly extend the lifespan under such stress. Efficacy of the bioactive compounds against three stress response genes of *C. elegans* (SIR 2.1, SKN-1 and DAF-16) had also been checked using molecular docking. The above findings that overall, *T. chebula* mediated the maximum lifespan extension of the worm could be attributed to the best fit docked models of the same to the above three gene products. These results provide an important lead towards designing evidence-based herbal therapy in future.

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**Department: Agricultural Biotechnology**

**Major Adviser: Dr. Basanta Kumar Borah**

## **Development of Multiplex PCR For Simultaneous Detection of *Candidatus liberibacter Asiaticus* and *Xanthomonas* spp. in Khasi Mandarin (*Citrus reticulata* L. Blanco)**

*Prerana Kalita*

Citrus decline has recently escalated into a serious issue that has significantly reduced its overall yield sometimes up to 60 to 95% mostly attributed to biotic stresses. Two significant diseases wreaking havoc on Citrus production are Citrus-greening (Huanglongbing) caused by *Candidatus Liberibacter asiaticus* (CLAs), a phloem-restricted, gram-negative bacteria and Citrus canker caused by *Xanthomonas* spp., a rod-shaped, gramnegative bacteria. Detection of these pathogens at an early stage is of utmost importance for early diagnosis and management. Therefore, the present study aimed to develop a multiplex PCR for simultaneous detection of both pathogens in Khasi Mandarin (*Citrus reticulata* L. Blanco). A series of novel primer sets were designed from different genomic regions of the chromosome for both pathogens (15 sets for *Xanthomonas* spp. and 21 sets for CLAs). Uniplex PCR was optimized for 7 sets of primers for *Xanthomonas* spp. and 14 sets of primers for CLAs. Finally, 3 sets of novel primer combinations for multiplex PCR were optimized and tested, which could efficiently detect the presence of both the pathogen and is very much comparable to uniplex PCR. Sequence comparison revealed that amplified fragments shared >94% identity with the corresponding regions of CLAs and *Xanthomonas citri* in the GenBank database. The multiplex PCR provides a useful rapid method for detecting multiple pathogens in Citrus plants that will aid in the production of pathogen-free citrus plants for rapid diagnosis and certification programs. To the best of our knowledge, this is the first time that a one-step multiplex PCR assay is developed using novel primer sets to detect the two most economically important bacterial pathogens, CLAs and *Xanthomonas* spp. simultaneously.

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**Major Adviser: Dr. Priyabrata Sen**

## **Studies on phosphate solubilizing bacterial isolates from root rhizospheric soil**

*Ratrismita Chetia*

The unavailability of phosphorus (P) in the soil due to its high reactivity with other soil nutrients could employ the strategic alternative of using phosphate solubilizing bacteria (PSBs) as biofertilizers to enhance the availability of P in the soil. In the present study, 24 PSB were isolated and purified from the root rhizosphere soil of sugarcane. They were further screened for P-solubilization out of which 5 strains viz; ABT-PSBI, ABT-PSBII, ABT-PSB07, ABTPSB08, ABT-PSB1 $\alpha$ , showed a strong ability to dissolve tri-calcium phosphate qualitatively and quantitatively in Pikovskaya (PVK) agar medium and PVK broth, respectively. ABTPSB08 showed the highest ability to solubilize P with a solubilization index (SI) of 2.8 at 72 hours of incubation in PVK agar and 39.33% P<sub>2</sub>O<sub>5</sub> solubilized percentage on the 15th day after inoculation in PVK broth. This strain was then characterized morphologically, biochemically and at molecular level (16S rRNA sequencing). The 16S rRNA sequencing showed 99.5% sequence homology with *Bacillus paramycooides*. Other plant growth-promoting (PGP) traits like production of indole acetic acid (IAA) and siderophores were also studied and found encouraging results. It showed 82.22  $\mu$ g/ml IAA production. A pot culture experiment was conducted considering rapeseed as the target crop and rock phosphate (RP) as the P source for the efficacy evaluation in both free and encapsulated forms of ABT-PSB08. The design of the experiment was completely randomized having 9 treatments with 3 replications. Both free and encapsulated form of ABT-PSB08 were applied along with different doses of RP (25%, 50% and 100% of recommended dose for Assam soil). Formulation along with recommended dose of N and K was kept constant for all the ABT-PSB08 treatment. Different controls were taken such as absolute control (no formulation, no phosphorus), formulation control (only formulation, no phosphorus), phosphorus control (only RP, 50% and 100%). Among the different treatments with free formulation, across the different stages of crop growth, 50% RP+ free formulation showed the highest available soil-P (71.4 kg/ha, 74.86 kg/ha, 38.33 kg/ha on 30th, 60th and 90th day, respectively), shoot length (9.77cm, 14.86cm, 16.3cm on 30th, 60th and 90th day, respectively), root length (5.5cm, 5.61cm, 5.83cm on 30th, 60th and 90th day, respectively), no. of leaves (5.17 nos.) and siliquae per plant

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(4.11nos.), crop biomass (4.72 g/plant), seed yield (1.87 g/plant) and total P-uptake (703.195ppm). Among the different treatments with encapsulated formulation, across the different stages of crop growth, 50% RP + encapsulated formulation showed the highest levels of soil P (59.08kg/ha, 71.86kg/ha, 50.47kg/ha on 30th, 60th and 90th day, respectively), shoot length (8.25cm, 17.83cm, 18.23 cm on 30th, 60th and 90th day, respectively), root length (5.14cm, 5.81cm, 6.57cm on 30th, 60th and 90th day, respectively), no. of leaves (5.67nos.) and siliquae per plant (6.78nos.), crop biomass (5.52 g/plant), seed yield (2.5g/plant) and total P-uptake (745.735ppm). The encapsulated formulation performed better than the free formulation for all the studied parameters and amongst all the different treatments suggesting that it could establish itself better in the plantsoil niche. The dependence on the use of chemical fertilizers could be reduced considerably with the combined application of PSB in rapeseed crop. Similar studies could be extended to other crops of agricultural importance.

## **Molecular Analysis for Cold Tolerance at the Booting Stage in Boro Rice of Assam**

*Samir Panika*

*Boro* rice is a winter season, photo-insensitive, transplanted rice cultivated on supplemental irrigation. However, the *boro* rice is adversely affected by low temperature in its vegetative stage, and at the booting stage, if planted early. The study was conducted to assess marker-based screening of *boro* rice germplasms for QTLs associated with booting stage cold tolerance and understand their genetic relatedness. A total of 14 markers linked to 11 different QTLs were employed, out of which 11 markers showed polymorphism and only seven detected desired marker alleles. The number of marker allele/s ranged from one (13 accessions) to four (9 accessions), whereas the allele share was maximum for RM 3719. However, no marker allele linked to the booting cold tolerance QTL was detected for three accessions (AccKMJ180, AccKMJ95, AccKMJ106). Cluster analysis revealed three main clusters. The cluster I, II and III were composed of 14, 24 and 16 accessions, respectively. A total of eleven groups with varied inclusions were sub-grouped with same genetic distance. Only 18 accessions were detected with genetic difference within sub-groups. When compared, the study could not establish any relationship between cold tolerance capacity and allelic composition of markers for known QTLs at the booting stage in 54 rice accessions, suggesting that possession of marker alleles in *boro* rice accessions might not carry the target QTL or there might be weak linkage between marker and the QTL. Therefore, extensive phenotyping for cold tolerance at the booting stage with more number of *boro* rice genotypes/accessions may facilitate designing of breeding experiment to establish strong marker-trait association.

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**Major Adviser: Dr. A. R. Baruah**



## **Studies on phosphate solubilizing fungal isolates from root rhizospheric soils**

*Tuhinendu Dey*

Phosphorus (P) unavailability is one of the limiting factors that adversely affect agricultural production though it is present abundantly in soils both in organic and inorganic forms. Although, chemical fertilizers are being applied to the soil to increase the availability of P for plants, a large proportion of it gets rapidly immobilized and becomes unavailable to the plants that can lead to an overall reduction in soil fertility after application. Also, the high reactivity of soil-P with Fe and Al in acidic soils of Assam causes its precipitation and it is rendered insoluble by forming complex molecules. However, P-solubilizing microbes play an important role in increasing the availability of soil-P for plant growth. The aim of my research was to isolate and purify indigenous potential P-solubilizing fungi from the rhizospheric soils of Maize, Cow pea and Soybean for the development of an eco-friendly and effective P-solubilizing fungal formulation. With this aim and objective, initially, five fungal isolates viz., PSF1, PSF2, PSF3, PSF4 and PSF5 were isolated and purified based on their ability to hydrolyse Tricalcium phosphate present in Pikovskaya (PVK) agar plates. These were further screened for P-solubilizing efficiency both qualitatively in PVK agar plate and quantitatively in PVK broth. In case of qualitative test, the solubilization Index (SI), and in quantitative test, the P-solubilization percentage (PS,%) were considered as the assayed parameters. Among the five fungal isolates, PSF4 showed the highest P-solubilizing efficiency in both PVK agar (SI, 1.88) and PVK broth (PS, 91.1%). Therefore, only PSF4 was taken for further study. The PSF4 isolate was characterized based on colony morphology, microscopic observations and molecular studies. Finally, from all the observations and studies, PSF4 was identified as *Aspergillus* spp. A pot culture experiment was carried out in the Department of Agricultural Biotechnology, Assam Agricultural University, Jorhat with rapeseed, variety TS29 and rock phosphate (RP) as the source of P for the efficacy evaluation of the fungal isolate both in free as well as encapsulated forms. The experiment was fitted to CRD with 9 treatments and 3 replications for each treatment. The application of recommended dose of P was considered as 100%. As the treatments, 50% and 25% RP were applied along with the encapsulated and free formulation of PSF4. Recommended doses of N and K were given

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in all the treatments at 2 days before sowing. Controls were kept accordingly. Soil analysis showed that the application of both free and encapsulated PSF4 formulations increased the available P significantly but not the soil-N and -K over controls. However, significant increase in P absorption, plant biomass and yield was observed due to application of both free and encapsulated formulations of PFS4 over all the different controls. But, the application of encapsulated formulation of PSF4 showed better results in terms of P-absorption, biomass production and yield than that of application of free formulation. From the present study, finally, it can be concluded that the isolate, PSF4 (*Aspergillus* sp.) has good potential to solubilize insoluble P-compounds in soils and that's why it can be used as an important bio-resource for soil fertility management, more specifically, in improvement of soil-P nutrient status. Its use as biofertilizer also can be helpful in reducing application of phosphoric fertilizer in crop production. Use of PSF4 formulation can be extended to cereals and legumes besides other oil seeds crops. Trial of use this formulation can be further extended to alkali soils. PSFs along with Arbuscular Mycorrhizal fungi (AMF) can be much more effective in the utilization of soil-P. Even, the use of different combinations of P-solubilizing bacteria (PSB) along with PSF could also be studied to increase their P-solubilization efficiency for better crop-soil-P management practices.

## **Assessment of Climate Change Impact on Rice Productivity in the Lower Brahmaputra Valley (LBV) zone of Assam**

*Jemima Hussain*

The present study investigates the trend in area, production and productivity of winter rice along with meteorological parameters, namely, temperature and rainfall during 1990-2019 and impact assessment of temperatures and rainfall on observed rice yield in the lower Brahmaputra valley (LBV) zone of Assam. In the zone, winter rice covers an area of 5.18 lakh ha with a production of 1.128 million tonnes and productivity of 2169 kg/ha. The rate of change of productivity with respect to linear time trend was found to be 35.82 kg/ha/year in the LBV zone. The decadal compound annual growth rates (CAGR) for winter rice area during 1990-2019 were negative with statistically significant negative growth observed during the decades 1990-1999 and 2010-2019. However, the growth rates for production and productivity were positive in the zone. Maximum growth rate (2.51%) for productivity was observed during the recent decade (2010-2019). Theil Sen's slope method was used to detect the trends of temperature and rainfall during the growing season of winter rice and Mann-Kendall rank test was applied to understand the statistical significance of the trends. Results revealed that there was a significant increasing trend in maximum temperatures for the months of August, October (Reproductive phase) and November (Maturity phase). Minimum temperature showed increasing trends in August, October and November and decreasing trends in July and September. A significant increase in average temperature during maturity phase was also observed. Rainfall in different months of the growing season of winter rice exhibited no significant trend except for the month of September where it increased significantly by 4.38 mm/year. A strongly balanced district-wise panel data (yield and climatic variables viz. Tmax, Tmin and rainfall during different pheno-phases) was used to assess the impact of climatic variables on the observed yield of winter rice during 1990-2019. Fixed effect regression model based on Hausman test was used to determine the relationship between yield and climatic variables. The coefficient of determination (R<sup>2</sup>) value revealed that variables included in the model explained variation in observed rice yield up to 71 per cent. Regression results indicated

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that the maximum temperature during vegetative phase was negatively associated while it was positively associated with yield during reproductive and maturity phases. The minimum temperature during vegetative and reproductive phases was positively correlated with rice yield whereas during maturity phase, it was negatively correlated. Results also revealed the maximum and minimum temperature during vegetative and maturity phases and rainfall during vegetative phase were statistically significant. The maximum and minimum temperature during vegetative and maturity phases played significant role in determining the yield of winter rice during the study period. Rainfall in all the three phases had a negative impact on yield but the extent of impact on yield was negligible compared to that of temperature. Time trend (T) on the observed yield was positive and statistically significant, implying positive effects of technological advancement on the observed yield of winter rice in the study area. The present study is only an indicative of the extent of loss which could be occurring in yield due to changes in the climatic variables. Given the severity of winter rice yields to climatic factors, specific adaptation strategies like adjustment of transplanting time, growing of heat tolerant varieties must be adopted to mute the adverse effects of climatic variables. Availability of timely weather information and the development of climate-resilient varieties are two key options that the researchers and policy makers should urgently address.

## **Moisture availability index and dry and wet spell based crop planning in Lower Brahmaputra Valley Zone (LBVZ) of Assam**

*Lagnajeet Roy*

The present research work was carried out for seven districts viz., Dhubri, Barpeta, Bongaigaon, Goalpara, Kamrup, Kokrajhar and Nalbari under undivided Lower Brahmaputra valley zone of Assam (LBVZ) to find out the probabilities of occurrence of dry and wet spells, and moisture availability (or adequacy) index (MAI) to suggest suitable crop planning in the region. Long term rainfall and temperature data for 31 years were collected from IMD, Pune. The probability analysis for occurrence of dry and wet spell was carried out by using Markov chain model which calculates the initial, conditional and consecutive probability. The MAI was calculated using Thornthwaite's formula (1948). Rainfall analysis revealed that annual rainfall along with CV and SD of Kokrajhar is moderately higher than the rainfall of other districts where as Kamrup has least. Seasonal rainfall analysis indicated that monsoon season receives the highest amount of rainfall with least CV and the winter records the lowest rainfall with higher CV in all the districts. Rainfall analysis revealed that monsoon season is very much ideal for agricultural enterprises in the region. From the result of initial probability, it was found that probability of occurrence of wet spell of minimum 10 mm of threshold limit was high from 13 th SMW (26th March – 1 st April) to 41st SMW (8th – 14th Oct) in most of the districts. The consecutive probability of occurrence of wet spell of two weeks is more than 50% from 15th SMW (9th April – 15th April) onwards in all seven districts. There was a higher chance of getting wet spell of three consecutive weeks of more than 40 mm rainfall in 25th SMW in Dhubri, 21st to 27th SMW except 24th SMW in Barpeta, 22nd to 28th SMW in Bongaigaon, 25th to 27th SMW in Goalpara, zero possibility for Kamrup, 21st to 27th SMW in Kokrajhar, 25th to 27th SMW in Nalbari which may lead to flood like condition in Kokrajhar and Bongaigaon districts. So, harvesting of the excess moisture as well as provision of drainage in the crop field is suggested during the aforesaid period. The probabilities of occurrence of dry spell were higher before 12th SMW and after 42nd SMW, but during monsoon season it was found to be very less which indicates that kharif crops can be grown without any supplemental

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irrigation. MAI value increases more than 0.95 in 17th to 18th SMW in sandy loam (100 mm WHC) soil for the districts but in Bongaigaon it is from 16th SMW and in silty clay loam (200 mm WHC) soil MAI > 0.95 from 17th SMW. In all the MAI remains continuously >0.90 upto 38th SMW in sandy loam soil and upto 40th SMW in silty clay loam soil in all the districts. Distribution of annual and seasonal rainfall and MAI is defined through geospatial mapping. Choropleth map of LBVZ is made on the basis of the data of average of 31 years. The western part of the LBVZ contain highest amount of rainfall and show a decreasing pattern when coming to east and same for MAI too. Sowing of summer crops such as greengram, blackgram, ahu rice were suggested from 13 th SMW onwards for all the districts. Sowing of maize and sesame were suggested to complete within 12th SMW. For sowing of jute one pre sowing irrigation must be given. Nursery bed preparation for sali rice can be started from 20th SMW in all the districts and transplanting can be done during 25th – 30th SMW. Sowing of kharif greengram and blackgram could be started from 36th SMW. Sowing of rabi crops such as rabi maize, potato, peas, rapeseed and mustard, linseed, niger can be started from 40th SMW.

## **Identification of critical weather parameters on infestation of rice stem borer in winter rice under Agro-climatic conditions of Jorhat**

*Sannidhya Sourav Buragohain*

The present study was carried out during kharif season 2019 at Assam Agricultural University, Jorhat to validate the results of identification of critical weather parameters on infestation of rice stem borer in winter rice under Agroclimatic conditions of Jorhat. Rice stem borer is a major insect pest of rice which causes considerable yield losses in rice crop. The current experiment aimed to find out the effect of environmental factors on incidence of insect pest. These finding may give valid methods to identify environmental conditions that is favourable for the development of a specific insect pest. During the course of investigation, the incidence of stem borer recorded from 32 nd SMW to 40th SMW, it occurred from third week after transplanting and reached a peak in 37th SMW. Thereafter, the infestation showed a steady fall. Percent white ear head was recorded from 41st SMW to 44th SMW. Stem borer population showed high build-up and peak activity during 37th SMW. The correlation study of present stem borer population found that an increase in minimum temperature and bright sunshine hours had a depressing effect, whereas increase in morning relative humidity favoured stem borer infestation. It was found that the intensity of dead heart and white earhead infestation was recorded maximum in TTB-404 followed by Mahsuri. The infestation of stem borer was lowest in Swarna Sub-1 cultivar compared to the other two cultivars. From all the three microclimatic regimes, it was observed that infestation of dead heart and white earhead was lowest in MR-I followed by MR-II and MR-III irrespective of the cultivars. Multiple regression equations were established to forecast the infestation of rice stem borer with meteorological parameters. The model equation for MR-I, MR-II, MR-III irrespective of variety, were  $PI = -20.47 + 0.66 \times T_{max} + 0.73 \times RD$  ( $R^2=78.2\%$  and adjusted  $R^2=73.8\%$ ),  $PI = -15.35 + 0.49 \times T_{max} + 0.88 \times RD$  ( $R^2=75.7\%$  and adjusted  $R^2=70.9\%$ ),  $PI = -7.39 + 1.68 \times T_{max} - 1.15 \times T_{min} - 1.80 \times BSSH$  ( $R^2=90.2\%$  and adjusted  $R^2=78.5\%$ ) respectively. The Model equation for Mahsuri, Swarna Sub-1 and TTB-404 irrespective of microclimatic regimes, were  $PI = -19.07 + 0.60 \times$

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$T_{max}+0.89 \times RD$  ( $R^2=83.5\%$  and adjusted  $R^2=80.3\%$ ),  $PI = -2.43+0.38 \times T_{max}-0.15 \times RH_{II}+1.21 \times RD$  ( $R^2=79.2\%$  and adjusted  $R^2=72.3\%$ ),  $PI = -6.80+0.48 \times T_{max}-0.13 \times RH_{II}+1.18 \times RD$  ( $R^2= 83.2\%$  and adjusted  $R^2= 77.6\%$ ) respectively. The findings of present study on pest weather model for rice stem borer of Sali rice would be useful for early warning and operational rice management practices for RSB attack. Forewarning of *S. incertulas* is specific for Jorhat for Sali season, and is expected to help the rice grower in the region.



# **Trends and Prospects of Female Labour Force Participation Rate in Agricultural Sector and Its Linkage with Fertility in Assam**

*Abhishek Thakur*

Labour Force Participation Rate” is the proportion of the population attaining the age group 15-59 years, that are economically active and who could supply the labour for the production of goods and services during a specified period. Under this study, all the necessary data has been collected from secondary sources, which include census of India, Statistical handbook of Assam and Economic survey of Assam. The objectives of the study are 1. To assess the age-period-cohort effects on the structural change in female labour force participation rate in the Agricultural sector. 2. To examine the linkage between female labour force participation rate in the Agricultural sector and fertility in Assam over time. 3. To identify the factors responsible for structural change in female labour participation rate in the Agricultural sector. In this study, we have used Gompertz growth curve and forecasted the female labour force participation rates for the year 2021, 2022 and 2023. Under Gompertz growth curve, we have used method of three selected points to forecast the labour force participation rate for each age group by estimating their corresponding trend equations. The study also revealed that there is no significant relationship between female labour force participation rate and female fertility rate over the time. For this, spearman rank correlation was used to see the relationship between female labour force participation rate in Agricultural sector and female fertility rate in Assam. Similarly, we have used multiple linear regression to see the factors responsible for the structural change in female labour force participation rate and we have found that female literacy rate has positive and significant impact on female labour force participation rate. Therefore, the study revealed that if the female’s level of education were improved, there would be a significant increase in labour force participation for female in the Agricultural enterprises in Assam.

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# **The Impact of Climate Change over the Production of Sericulture with Special Reference to Assam**

*Anshuman Neog*

Climatic condition play a very significant role in the diversity of agriculture from region to region. The impact of climatic parameters on crop health is mostly influenced by the variabilities in local or regional climate rather than the global climate patterns. Assam is well-recognized for its genetic diversity of sericultural crop viz. Eri, Muga, Mulberry. The climatic condition and geographical location cause greater production of sericultural crop over the past in Assam. Muga is the leading sericultural crop, accounting for a major portion of the total sericultural production in Assam as well as in India. In this study, an attempt has been made to find a better implementable plan for the farmers and policy makers to increase the sericulture crop production of Assam by analyzing over fifty years of data. Assam is one of the main regions, where most of its livelihood depends on agriculture. The purpose of the study was to analyze the trend of production of sericulture crop and to estimate the impact of climatic parameters in sericulture production and forecasting sericulture production of Assam. Overall fifty years (1971-2020) of secondary data were evaluated for the study. To make a more clear vision, again data were sub-divided into ten years duration. The non-parametric method Mann-Kendall test confirmed the trend pattern of sericulture crop production along with Sen's slope estimate of the rate of change per year of production. Although, multiple linear regression has been performed to estimate the effects of climate change on sericulture crop production and a time series model has been used for forecasting. The three weather parameters viz. temperature, humidity, and rainfall were considered for climatic impact assessment. These parameters possess the most significant fluctuations of sericulture crop production of Assam. Analyzing over the past fifty years of the dataset resulted that the production of sericulture crop being highly influenced by temperature and rainfall. The four stages of Box-Jenkins approach were used to create an appropriate ARIMA model, which is used for sericulture production for next ten year (2021-2030). The analysis over the past decades of Assam was to provide essential information to the agricultural planner and policymakers responsible for designing

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efficient agricultural policies and for making significant decisions concerning resources allocation for the development of the agricultural sector in Assam. The study revealed that Assam is not limited for studying climate-resilient productivity of sericulture only, there is a great need for implementation of effective measures as crop production and productivity has a greater influence on the socioeconomic needs of the people.

# **A Statistical Study on the Growth of Agricultural Sector on Indian Economy with special reference to Assam**

*Dikhita Saikia*

Agriculture contributes significantly to India's productivity and employment as well as that of Assam, which is predominantly agricultural and overpopulated. Agriculture production in the state is below the national average. Knowledge of productivity trends of major crops is critical in various decision-making plans for the benefit of farmers. Several methods are used to calculate income of a state, the most important of which is Gross State Domestic Product (GSDP). Assam's GSDP growth rate is critical for assessing the state of the economy. As a major component of a state's GDP, the agricultural growth rate should be prioritized in order to increase farmer income and the per capita income of Assam's rural community. Keeping the aforementioned facts in mind, the present study was planned with the objectives: To study the trends and prospects of the productivity of the major crops and its contribution to GSDP of Assam; To study the growth of agricultural GDP versus total GDP growth rate in the state; Modeling of the economic growth rate of the agricultural sector in the state; Forecasting of GSDP with time series models. The data pertaining to the study were based on secondary data for the period of 31 years (1990 to 2020). From the results it was observed that rice, jute, rapeseed and mustard had a significant increasing trend in productivity. About 95.14 per cent of the variation in the GSDP of Assam was explained by the production of the six major crops viz. rice, jute, wheat, potato, sugarcane, rapeseed and mustard. Agricultural GSDP contributed a large percentage of total GSDP during the nineteenth century. It was found that total GSDP had a higher growth rate than agricultural GSDP growth rate but Agricultural GSDP had the highest standard deviation, indicating greatest variability in growth rate. By comparing the results of the Solow Growth model to actual data, a very close relationship was discovered between the actual (11.28 per cent) and calculated (12.13 per cent) average growth rates from 1990 to 2020. The four stages of the Box-Jenkins approach were used to create an appropriate ARIMA model for Assam's GSDP, which later used to forecast Assam's GSDP for the next ten years (from 2020 to 2030). Based on the forecasted values from our model, we expect Assam's GSDP continue to rise.

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# **Impact of Weather Parameters on Winter Rice Productivity in North Bank Plains Zone of Assam**

*Rabijita Buragohain*

Weather parameters play a very significant role in the diversity of agriculture from region to region. The impact of weather parameters on crop health is mostly influenced by the variabilities in local or regional climate rather than the global climate patterns. Assam is well-recognized for its rich genetic diversity of rice. The climatic condition and geographical location cause greater production of rice over the past in Assam. Winter rice is the leading rice crop, accounting for a major portion of the total rice production in Assam as well as in India. In this study, an attempt has been made to find a better implementable plan for the farmers and policy makers to increase the winter rice productivity in North Bank Plains Zone (NBPZ) of Assam by analyzing over thirty years of data. NBPZ is one of the main regions, where most of its livelihood depends on agriculture. The purpose of the study was to analyze the trend of area, production and productivity of winter rice and to estimate the impact of weather parameters in winter rice productivity in NBPZ of Assam. Moreover, the analysis also revealed inter-district and intra-district variation of weather impacts on winter rice productivity. Overall thirty years of secondary data were evaluated for the study. To make a more clear vision, again data were sub-divided into three decadal periods viz. period I (1988-89 to 1997-98), period II (1998-99 to 2007-08) and period III (2008-09 to 2017-18) respectively. Different statistical tools viz. homogeneity test and change point detection of the data series over the decadal and overall thirty years were evaluated. Pettitt's test and Buishand's test were used to confirm the change point of the period. The robust non-parametric Mann-Kendall test confirmed the trend pattern of winter rice productivity in NBPZ along with Sen's slope estimate of the rate of change per year of area, production and productivity. Although, stepwise multiple linear regression was performed to estimate the effects of climate change on winter rice productivity. The four weather parameters viz. maximum temperature, minimum temperature, rainfall and rainy days were considered for weather impact assessment. These parameters possess the most significant fluctuations in the NBPZ of Assam. Analyzing over thirty years of the dataset for the aggregate of NBPZ also resulted that the productivity of winter rice

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being highly influenced by maximum temperature and minimum temperature. Although, Period III of Sonitpur and Lakhimpur district, the number of rainy days were found significant for winter rice productivity. The analysis over the past decades of NBPZ was to provide essential information to the agricultural planner and policymakers responsible for designing efficient agricultural policies and for making significant decisions concerning resources allocation for the development of the agricultural sector in NBPZ as well as for Assam. The study revealed that the NBPZ is not limited to studying climate-resilient productivity of winter rice only, there is a great need for implementation of effective measures as crop production and productivity has a greater influence on the socio-economic needs of the people. Keywords: Winter rice, NBPZ, weather parameters, MK-test, Stepwise multiple linear regression.

## **Rainfall Probability Analysis for crop planning of Unakoti and West Tripura**

*Somnath Ganchoudhuri*

The rainfall data of two districts of Tripura namely Unakoti and West Tripura for 20 years (2001-2020) were collected from Weather Stations under Airport Authority of India through Regional Meteorological Centre, Guwahati and were used to analyze annual, seasonal, monthly and weekly rainfall using statistical methods. It was also used to find and analyze weekly rainfall probability by using incomplete gamma probability module of WEATHER COCK software. The analyzed data revealed that the average rainfall for the last 20 years of Unakoti and West Tripura district were 2597.5 mm and 2138.4 mm respectively. The rainfall data also revealed that the districts of Unakoti and West Tripura district received about 1510.7 mm and 1272.5 mm during monsoon contributing about 58.2% and 59.5%, respectively to the total rainfall which is highest as compared to any other season. Also rainfall amount along with contribution total rainfall received in other seasons are 206.3 mm (7.9%) and 199.8 mm (9.3%) in post monsoon, 854.3 mm (32.9%) and 566.8 mm (26.5%) during pre monsoon followed by winter. The two districts of Unakoti and West Tripura district received highest rainfall of 500.2 mm and 450.3 mm in May and June respectively. Least rainfall of 5.5 mm and 2.7 mm was received during January in Unakoti and West Tripura respectively. Rainfall probability analysis is one of the most important tools to predict the rainfall of an area. The total annual rainfall of Unakoti at 90%, 75% and 50% probability is predicted to be 1640 mm, 1686 mm and 1722 mm respectively. The total annual rainfall of the West Tripura at 90%, 75% and 50% probability is likely to be 1631 mm, 1847 mm and 2108.4 mm respectively. The SWM 23 for Unakoti and SMW 24 for West Tripura is probably to receive highest rainfall in all the three level of rainfall probabilities (90%, 75% and 50%). Agro-climatic conditions of both the districts are quite similar, hence crops and cropping patterns in both the districts are same and do not vary much. The Risk proof crop which can be best suitable for kharif season are blackgram, greengram in medium and upland, aman rice in medium land and late aman can be grown in lowland condition. The crops which can be grown in rabi season are vegetables like cole crops, tomato, chilli etc along with potato, pea, toria etc. The crops grown in summer include short duration greengram, aush rice, sesame, jute in all land situations while early aush can be grown in lowland.

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## **Economic Assessment of Rice Milling Firms in Jorhat District of Assam**

*Ankit Chaudhary*

The state of Assam and Jorhat district is blessed with good resources for paddy cultivation but production of paddy should be accompanied with proper processing to obtain good quality of rice. The good quality of head rice can be obtained from a modern rice mills along with by-product like bran and husk. Rice mills are operating in the entire district of Jorhat in the state of Assam with higher capacity of 6 to 10 qt per hour in registered rice mill and lower capacity of 2 to 4 qt per hour in unregistered rice mill. There are 91 registered rice mills in the Jorhat district of Assam and unaccounted number of unregistered rice mills. Monthly installed capacity of the Jorhat district for the registered rice mill was 56000 qt and unregistered rice mill 17600 qt. Capacity utilization should be the priority of the rice mills as most of the blocks were operating at a capacity utilization of less than 50 percent with conversion ratio of the rice mills in Jorhat district was 67.80 percent for the registered rice mills and 59.13 in the unregistered rice mills. Among all the blocks highest monthly capacity utilization was of central Jorhat dev. Block due to better performance of rice mill in the concerned block. Economically the rice mills in Jorhat district was in stable and sound condition. In case of RRM Net return per rice mill per quintal of paddy processed in the Jorhat district was Rs. 439.29 and Rs. 387.92 in the year 2019-20 and 2020-21 respectively. In case of URM net return per rice mill per quintal of paddy processed in the Jorhat district was Rs. 100.30 and Rs. 110.84 in the year 2019-20 and 2020-21 respectively. Best performing block in Jorhat district in terms of net return was Jorhat dev. Block in RRM as well as in URM. Overall economic scenario of rice mill is depicted through financial ratios i.e., Fixed ratio and Gross ratio. Fixed ratio of Jorhat district for registered rice mill was 0.0050 and 0.0158 in the year 2019-20 and 2020-21 respectively. Gross ratio of Jorhat district for registered rice mill was 0.7434 and 0.7812 in the year 2019-20 and 2020-21 respectively. Fixed ratio of Jorhat district for unregistered rice mill was 0.0705 and 0.0686 in the year 2019-20 and 2020-21 respectively. Gross ratio of Jorhat district for unregistered rice mill was 0.2818 and 0.2337 in the year 2019-20 and 2020-21 respectively. Labour efficiency ratio shows the net returns generated for each rupee

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spent of wages and break-even analysis shows that all the blocks in the Jorhat district were having rice mills operating at higher output than break-even output. Rice mills in Jorhat district of Assam faces various issues and most important among them is free distribution of ration which disturb the market forces.

# **Economic Assessment of Household Food Security in Rural Urban Interface in Biswanath District of Assam**

*Ankush Sarmah*

A study on “Economic assessment of household food security in rural urban interface in Biswanath district of Assam” was conducted to estimate the overall food security scenario of the concerned district. The goal of the study was to estimate the food security status of urban and rural homes, as well as to evaluate household income levels, current food security status and the factors impacting the food security of the sample households and also coping mechanisms adopted by them for maintaining food security. A stratified purposive random design was used for this inquiry. Three phases made up the example plan. The transect (east or west) was the initial sample unit, followed by the village, town, or semi-urban and transition region, and finally the houses. From each transect, thirty households were chosen, and then ten households each from rural, township/urban, and ten from transition region were chosen. The sample consisted of 60 homes in total, 30 from the west transect of Biswanath (10 from urban, 10 from transitional, and 10 from rural), and 30 from the east transect (10 from urban, 10 from transitional, and 10 from rural). The findings of the study showed that caloric consumption in the rural, transitional, and urban sections of the east transect were, respectively, 3061, 2633, and 2869 kcal/CU/day, according to an analysis of data across gradients. The similar numbers for the west transect were 3040 kcal/CU/day, 2676 kcal/CU/day, and 2320 kcal/CU/day. The actual calorie consumption in rural areas was greater than that in urban and transition areas in both transects. In both transects, urban regions had disproportionately high ratios of actual to recommended calorie consumption. The results also revealed that the households with food security had larger households (adult equivalent) and dependency ratios (the ratio of dependents to household members) in rural areas in both transects. The food secure households' daily calorie intake was higher in the east transect (2889 kcal/capita/day) than the west transect (2866 kcal/capita/day). The Food Security Index (FSI=Z) was found to be 1.12 rural area in the west transect and 1.11 in east transect. The same was found to be 1.23 and 1.00 in urban area for West and east transect respectively. While for transition areas

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it was found to be 0.98 for both west and east transects. The households in the study area had a head count ratio (H) for food secure households of 0.56 for the west transect and 0.53 for the east transect. Among the dependent variables in the model, the dummy for the west transect and per capita income had significant influence on the food security of respondent families. Food security, however, was adversely correlated with family size. The employment from agricultural and non-agricultural sources, per capita income, and the urban dummy are those that substantially and positively affected the food security status. Family size has a big influence on food security but was found to be negative. Households working in the agricultural sector and as agricultural labor had a lower percentage of food-secure families than households working in other sectors because farm revenue or farm yield depends on the climate and varies accordingly. In contrast, people employed in the government sector and in off-farm and non-farm activity had stable and predictable incomes though those employments were informal and unorganized in the study area. According to the statistical analysis of the data, there were significant discrepancies in the amounts spent by various income groups on other foods, nuts and oilseeds, milk and milk products, fats and oils, sugar and jaggery. Other vegetables were much more expensive for those with low and middle incomes. The amount spent on nuts and oilseeds by the high income group was significantly higher than the amount spent by the low income group and middle income group. Similarly the spending on milk and milk products as well as fats and oils was significantly higher by high income and upper middle income families than by middle income and low income groups. The results also showed that as the income of the households rose, they were more inclined towards buying meat and meat products, milk and milk products, fats and oils and pulses. The study showed that families made use of adaptation strategies to minimize food shortages brought on by poor crop output. These strategies included sending family members out to eat, setting mealtime portion size restrictions, prioritizing young children's consumption over adults, reducing the number of meals consumed daily, going without food for entire days, borrowing food, and enlisting the help of friends and family. Other strategies included hunting, obtaining food from the wild, and harvesting young crops. The results demonstrated that when CSI ratings increased, families increasingly turned to consumptionbased coping mechanisms. Compared to homes with high CSI scores, households with low CSI ratings engaged these consumer coping mechanisms less frequently. The primary take away from this section is that less often used coping techniques were used which was due to revenue from food production and produce sales. As a result, income from produce sales and consumption of food grown on-site helped to safeguard households from food insecurity.

# **Assessment of Agricultural Loss and Mitigation Strategies among the Flood Affected Farmers in Dhemaji District of Assam**

*Arpan Buragohain*

The present study was conducted in Dhemaji district of Assam for the “Assessment of agricultural loss and mitigation strategies among the flood affected farmers in Dhemaji district of Assam”. Multistage random sampling technique with proportional allocation was used for selection of the 120 respondents. Based on area farmers were classified into two groups; Group I (below 1 ha), Group II (1 to 2 ha). The study revealed that Dhemaji was one of the flood affected district of Assam. From 2018-2022 the total population affected and crop affected area in Dhemaji district was 240799 (nos.) and 14232.41 ha respectively. Total loss for the group II (Rs.39094.33) farmer is high as compared to the group I (Rs. 36643.3) farmers. Service sector shows the highest contribution towards mitigating the flood for both group I and group II. Several problems were raised due to flood from which damage house problems shows the highest percentage. Different coping mechanisms and risk management strategies were adopted by farmers due to flood. Use of modern inputs and flood tolerant varieties like Swarna Sub 1, Ranjit Sub 1 etc. can increase the rice production in flood affected area. Awareness and more extension contact will encourage the farmers to avail the schemes like PMFBY, RKVY etc. which will help the farmers to increase their income.

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**Department: Agricultural Economics & FM**

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## **Economic Analysis of Integrated Farming Systems in Upper Brahmaputra Valley Zone of Assam**

*Arpita Dutta*

Integrated farming is that form of farming which is engrossed in creating interrelationship between different natural components such as agricultural crops (field crops and horticultural crops), fishery, dairy, poultry, duckery, apiculture, sericulture etc. with the aim of optimizing the exertion of inputs of all the integrated farming systems and allaying the adverse negative ramifications of these enterprises on environment. It can be also defined as farming practice which involved in minimization of waste materials of one enterprise by reprocessing them to make it reuse for other enterprises. In Assam, each and every household have a homestead garden and a pond with fishes, which are mostly adjacent to their houses. Among the different types of integrated farming systems, integrated fish farming is identified as one of the most promising farming system in Assam. Because, demand for fish is very significant in Assam and it has tremendous potential to generate additional employment opportunities and net income. The present study was undertaken in Upper Brahmaputra Valley Zone of Assam to identify different integrated farming systems, their economics, impact and various constraints encountered by the farmers during the adoption of different integrated farming systems. Among the seven districts under UBVZ, only three district i.e. Sivasagar, Jorhat and Golaghat were selected purposively based on availability of integrated farming. Primary data of 160 sample farmers from three district of Assam were selected randomly for the study through face to face interview method with the help of pre-tested schedules and questionnaires. The total sample size for the present study was selected in two parts i.e. out of 160 sample farmers, 120 sample farmers practicing IFS and remaining 40 sample farmers practicing Non-IFS were selected randomly from the tree district. Among the different integrated farming systems, three major integrated fish farming systems were found to adopt by the sample farmers to a large extent. They are as follows integrated pig -fish farming (IFS-I); integrated duck - fish farming (IFS-II) and integrated poultry-fish farming system (IFS-III). The sample farmers practicing IFS-I, IFS-II and IFS-III in the study area were found to be 52, 41 and 27 numbers respectively. The necessary data collected from the sample famers had reference to the year 2020-21. The sample population under various categories of IFS

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**Department: Agricultural Economics & FM**

**Major Adviser: Dr. P.B. Gogoi**

and Non-IFS comprised of highest number of male population rather than female population. More than half (55.79%) of the population were middle aged (15-60 years) and one third (33.00%) of them were educated up to high school level. With regards to occupation, majority of them were found to engage in farming followed by business and service. Among the three IFS, IFS-III hold the highest amount of total operational land holdings (2.69 ha) followed by IFS-II (2.61ha) and IFS-I (2.53 ha). Under uncultivated land, land utilized for integration of fish and livestock component for all farms in case of IFS-I, IFS-II and IFS-III was found to be 0.38 ha, 0.34 ha and 0.32 ha respectively and in case of Non-IFS, the land used for practice of fish farming was found to be 0.39 ha. The cropping intensity of IFS-I, IFS-II, IFS-III and Non-IFS were measured to be around 153.75 per cent, 158.51 per cent, 164.27 percent and 147.39 per cent, respectively and with regards to cropping pattern, Sali paddy was observed to be major crop in the study area, which accounted for highest percentage of gross cropped area. Input utilization pattern of different IFS and Non-IFS was also observed in order to analyze the first objective of the study. The economics of various integrated fish farming as well as non-integrated fish farming has been figured out and it has been found that IFS-I i.e. fish cum pig farming incurred highest amount of total expenditures (Rs. 7,03,958.44/ha) for an average farm as compared to other types of farming. With regards to income, the average net income to tune of Rs.9,37,256.43, Rs. 4,51,839.25, Rs. 7,08,145.07 and Rs. 2,56,270.19 were found out from integrated pig -fish farming (IFS-I), integrated poultry -fish farming (IFS-III), integrated duck-fish farming system (IFS-II) and traditional fish farming (Non-IFS), respectively. The average benefit-cost ratio of 2.32, 1.91 and 2.19 were recorded from integrated pig -fish farming, integrated poultry -fish farming and integrated duck-fish farming system respectively whereas 1.64 from non-integrated fish farming. Thus, all the three IFS were found to be more profitable and remunerative over Non-IFS. The study has reported that the practice of integrated pig -fish farming; integrated poultry - fish farming, integrated duck-fish farming system generated additional net income of Rs. 6,80,986.24 /ha, Rs. 1,96,983.63/ha, Rs. 4,51,874.88/ha of pond area over the traditional fish farming system. In fish cum poultry farming system, involvement of labour was maximum i.e IFS-III was labour intensive (295.91 man days/ha) over the other integrated farming system. The study also unearthed the fact that integrated fish-pig farming (IFS-I) was the most extensively practiced farming system and was found to be the most lucrative enterprise followed by fish-duck and fish-poultry integrated farming system. Various constraints such as lack of improved quality of fish seeds, wide variation in market condition and prices, lack of sufficient credit facilities were some of the common and severe problems faced by farmers of all the integrated farming systems.

# **An Economic Analysis of Rice-Fish Integrated Farming System in Arunachal Pradesh**

*Bini Yamir*

The study —An economic analysis of rice-fish integrated farming system in Arunachal Pradesh was undertaken with the specific objectives to estimate the cost and return of the rice- fish integrated farming, analysis and compare the profitability of ricefish integrated farming and rice mono cropping system and identify the major problems and suggest policy measures for integrated rice-fish farming. The study was conducted in Lower Subansiri district of Arunachal Pradesh. Purposive random sampling design was used to collect primary data from Ziro -I block of the district, and 100 samples comprising of 60 households with rice-fish integrated farming system and 40 households with rice mono cropping system were randomly selected from 10 villages during the crop year 2021- 22. Cost concept, t-test, technical efficiency, and Garrett ranking techniques were used to substantiate various objectives of the study. The finding of the study reveals that the average cost of cultivation of rice fish integrated farming system and rice mono cropping was Rs. 87928.08 per hectare and Rs. 69846.97 per hectare, respectively. The average production of rice and fish in rice-fish integrated farming system was 30.66 Qt/ha and 2.62 Qt/ha, respectively, while average production of rice in rice monocropping system was 30.04 Qt/ha indicating a negligible difference between the two systems. Per hectare gross returns and net returns from rice-fish integrated farming system was Rs. 186746.48 and Rs. 98818.40, respectively, while it was estimated at Rs. 106051.75 per hectare and Rs. 36204.79 per hectare, respectively for rice mono cropping system. The farm business income, owned farm business income, family labour income was also observed to be higher in case of rice-fish integrated farming system over rice monocropping system by 90.59 per cent, 91.06 per cent, and 91.96 per cent, respectively. Difference of all the incomes between rice-fish integrated farming and rice mono cropping system were found to be statistically significant at 1% probability level indicating that the rice-fish integrated farming system was more profitable as it ensured a spread of financial risk for its varied and diversified nature in rearing of fish and crop. However, a number of major problems exist in integrated rice-fish integrated farming system viz, breakage of bunds, high cost of inputs, less availability of fish seeds etc. and based on the findings of the present study few policy implications were also suggested.

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**Abstract of M.Sc. thesis**

**Department: Agricultural Economics & FM**

**Major Adviser: Dr. Horindra Gogoi**

# **Performance of Pradhan Mantri Fasal Bima Yojana in Central Brahmaputra Valley Zone of Assam**

*Biswarup Bora*

The present study was conducted in the Central Brahmaputra Valley zone of Assam to evaluate the “Performance of Pradhan Mantri Fasal Bima Yojana”. The Purposive, and multistage random sampling techniques were used for selecting the respondents and they were classified into two groups; Loanee insured farmers and non loanee insured farmers. The conventional statistical tools like percentage average was used to find out the governance of PMFBY and to check the extent of benefits accrued by the beneficiary farmers for crop loss due to biotic and abiotic stress, the binary logistic regression was used. The crop insurance scheme Pradhan Mantri Fasal Bima Yojana (PMFBY) has benefitted a large number of farmers in Central Brahmaputra Valley zone of Assam to overcome the financial loss resulting such crop failure due to natural disasters. PMFBY is showing significant growth in the study area. To identify the problems faced by the respondent while availing the benefits of PMFBY, Garrett ranking technique was used. The findings of the study revealed that majority of the farmers faced delay in claim settlement, Improper assessment of crop loss, Lack of facility at village level or door step, Unavailability of surveyor at the time of crop loss, Less crop coverage under the scheme, Lack of technical facilities for assessment of crop loss, Lack of communication and coordination between banks and farmers, Difficulties in processing and compensation of paper work, Additional subsidies in the premium should be allowed according to the extremities of disaster, Lack of banking facilities at rural areas, area approach etc. The regression analysis revealed there were important factors such as farm size, biotic and abiotic stress etc that influenced or encouraged farmers to received claim amount. With more area, bigger farm size and, more source of information, the farmers were found to be more aware about crop insurance in the study area. A well planned and well executed Pradhan Mantri Fasal Bima Yojana scheme always needs proper coordination as well as integration of government and farmers to achieve the desired goal. It can be concluded that by making provision for a better crop insurance scheme government can provide better standard of living to farmers and thereby ensure a better socio-economic development of the state.

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**Abstract of M.Sc. thesis**

**Department: Agricultural Economics & FM**

**Major Adviser: Dr. Manashi Gogoi**



## **Genetic Variability and Diversity in Rice (*Oryza sativa* L.) for Traits Related with Grain Yield and Thermal Indices**

*Daizi Durba Saharia*

Rice (*Oryza sativa* L.) is the leading cereal crop of the world which is consumed by more than 55 % of global population. To feed the increased population, as per an estimate, 50 % of more rice will be required by 2050. Keeping in view the present level of productivity growth this has been a challenging task based on the existing approaches. In recent years along with conventional yield component traits, emphasis has been laid on some physiological and related meteorological indices in order to achieve further gain in selection. This investigation aimed at studying the variability, character association and genetic diversity in a set of 58 rice germplasm of Assam for some conventional yield traits as well as traits related with thermal indices. The investigation was carried out during Kharif season of 2020 at the experimental field of Biswanath College of Agriculture. Data were recorded on eleven agro-morphological characters and three agro-meteorological indices. Analysis of variance indicated that GCV was highest for filled grains per panicle followed by total grains per panicle and yield per plant. High heritability (more than 90 %) was observed for all the characters except spikelet fertility (53.18). High heritability coupled with high genetic advance per cent of mean was observed for traits viz., days to 50 % flowering, plant height, effective tillers per plant, total grains per panicle, filled grains per panicle, 100-grain weight, grain yield per plant, biological yield and heat use efficiency. Selection thus, would be effective for these traits. At both genotypic and phenotypic level, highly significant association of all the characters with grain yield was observed. Path coefficient analysis revealed that panicle length, effective tillers per plant, spikelet fertility, 100-grain weight, biological yield, and helio-thermal unit had positive direct effect on yield at both phenotypic and genotypic level. Considerably high negative direct effect on yield was exhibited by growing degree days and heat use efficiency. Based on Mahalanobis' D<sup>2</sup> - statistics, all the genotypes were grouped into six diverse clusters following Tocher's method. The maximum number of genotypes were present in cluster IV followed by cluster VI. The intra-cluster distance ranged from 8.57 in cluster I to 313.79 in cluster V. The maximum

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**Abstract of M.Sc. thesis**

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inter-cluster distance was exhibited in between the clusters V and VI (1082.8), followed by cluster III and VI (752.43). Cluster I and II (53.63) exhibited the minimum inter-cluster distance. Based on the per se performance of the genotypes and considering their location in diverse clusters, Luit (lowest days to 50% flowering), Biriya Bhonga Bao (highest 100-grain weight, biological weight), Maizubiron (highest heat use efficiency), Konguti (highest total and filled grains per panicle) and Boga joha (highest GDD and HTU) were identified promising for undertaking hybridization programme. Efficient hybridization programme formulated among amongst these parents is expected to yield desirable segregants for their further utilization in breeding programme.

## **Economics of Production and Resource Use Efficiency in Rapeseed and Mustard Cultivation in Majuli, Assam**

*Debajit Das*

Rapeseed (*Brassica campestris*) and Mustard (*Brassica juncea*) are major Rabi oilseed crops of India. It is the third most important edible oilseed crop in the world after soybean and oil palm. An attempt has been made in this study to examine the economics of production and resource use efficiency in rapeseed and mustard cultivation in Majuli district of Assam for the year 2020-21. The total cost of cultivation of rapeseed and mustard per farm for the sample was found to be Rs.71782.03 and the operational cost and fixed cost per farm were recorded as Rs.45111.13 and Rs.26670.90, respectively. The highest percentage of total cost was incurred in operational cost (62.81 per cent) followed by fixed cost (37.19 per cent). The cost of cultivation per farm varied directly with farm size which was found to be highest in medium (Rs.115048.57) farm size followed by semi-medium (Rs.79698.77) and small (Rs.49301.29) farm size. Input wise highest cost was incurred on labour (27.48 per cent). Cost of cultivation of rapeseed and mustard per hectare varied inversely with farm size, which was found to be highest in small (Rs.47764.06) farm size followed by semi-medium (Rs.44873.70) and medium (Rs.41913.15) farm size. Study revealed that as farm size increased, bullock labour was substituted by machine labour and it was directly related to farm size. The average cost of cultivation (cost C2) per hectare of rapeseed and mustard was worked out as Rs.44850.31. The average cost A1, cost A2, cost B1, cost B2, cost C1 and cost C3 per hectare were Rs.25118.19, Rs.27590.61, Rs.29443.71, Rs. 38457.18, Rs.35836.84 and Rs.49335.54. The average yield of rapeseed-mustard per hectare was recorded as 13.93 quintals. The highest yield was found in small farm size (14.28 quintals) followed by semi-medium (13.26 quintals) and medium (12.41 quintals) farm size. The average net income realized from cultivation of per hectare of rapeseed-mustard was Rs. 27257.43. This was highest in case of small farm followed by semi medium and medium farm size on per hectare basis. The average B:C ratio in the study was found to be 1:1.61, which was higher at small farm size (1:1.70) followed by semi medium (1:1.61) and medium farm size (1:1.50). Farmers' technical efficiency was

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**Abstract of M.Sc. thesis**

**Department: Agricultural Economics & FM, BNCA**

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estimated to be 70.50 per cent on an average. An inverse relationship between farm size was observed. As indicated by input slacks draught labour was significantly excessively used. Farmers of semi-medium and medium farm size use excess of seeds. Input slack value of fertilizer was highly significant for all the farm sizes indicating excessive use of this input. The major constraints involved in rapeseed and mustard cultivation were high weed infestation, lack of technical knowledge, high incidence of pest and diseases, unfavorable product price, inadequate storage facilities and lack of proper transport facilities.

## **Production and Marketing of Assam Lemon in Nalbari district**

*Debasmita Baruah*

Assam lemon, which is most popularly known as Kaji Nemu in Assamese is indigenously cultivated and found in the state of Assam. In Assam cuisine of these lemons constitute an integral part and are used for preparing fresh drinks or beverages and can be dried or pickled which can be preserved for years. Assam lemon is a native dwarf cultivar of the state of Assam suitable for high density planting. The scientific name of Assam Lemon is *Citrus limon* and it belongs to the Rutaceae family. Assam lemon is enriched in aromatic oil and vitamin C and also a good source of iron, fiber, copper and calcium. Assam lemon is the highest grown citrus fruit in the state; it was observed that in the year 2018-19 the total cultivated area under Assam Lemon was 13802 hectares with a production of 1.19 lakh metric tonnes and the average yield per annum was 8645 kg/hectare. In this study an attempt was made to get a clear view on production and marketing aspects of Assam lemon by analyzing the growth rate of area, production and productivity of Assam lemon in the state, examine the economic feasibility of Assam lemon cultivation, study the marketing pattern of Assam lemon and to identify the constraints faced by the farmers. The study examined the trends and variation of area, production and productivity of Assam lemon in Assam as well as in Nalbari (undivided) district from 2009-10 to 2018-19. The compound growth rate of area (1.25\*, 9.65\*\*\*), production (2.53\*, 10.82\*\*\*) and productivity (1.26\*, 1.06\*) of Assam lemon showed positive behavior in Assam and Nalbari (undivided) district respectively. Considerable variability was also observed in case of area (5.75, 27.98), production (10.85, 30.09) and productivity (5.37, 10.3) of Assam lemon in Assam and Nalbari (undivided) district respectively. The change in total production was examined by additive decomposition and it was revealed from the study that yield effect contributed more to the change in production of Assam lemon in Assam whereas area effect relatively had stronger stimulus and contributed more to the change in production of Assam lemon in Nalbari (undivided) district. The study found that farm-category wise the expenditure on establishment of the crop was highest on medium farms and lowest on marginal farms thus implying that the total establishment cost incurred increased with increase in farm size. It was also observed that the total maintenance cost

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**Major Adviser: Dr. Nivedita Deka**

increased with increase in farm size. The total maintenance cost incurred was highest on medium farms followed by semi-medium farms, small farms and marginal farms. For overall farms the establishment cost amortized over 15 years at the rate of 6 per cent per year, average maintenance cost per year, total cost per year, average gross return per year and net return per year was estimated to be Rs. 4,502.96 per hectare, Rs. 60,075.27 per hectare, Rs. 64,578.23 per hectare, Rs. 2, 27,762 per hectare and Rs. 1, 63,183.77 per hectare respectively. The benefit cost ratio at 6 per discount rate, NPV at 6 per cent discount rate and IRR for overall farms worked out to be 3.8, Rs. 12,01,425 and 66.95 per cent respectively thus indicating that Assam lemon cultivation is economically viable and profitable and has the potential to generate additional revenue. Three marketing channels were identified in the study area viz, Producer- Pre-harvest contractor- Wholesaler- Retailer- Consumer, Producer- Wholesaler- Retailer- Consumer and Producer- Consumer. Through the first marketing channel products were transacted to distant places and through the second and third channel the products were sold in nearby markets. It was revealed that marketing channel III (Producer - Consumer) was found to be more efficient whereas the marketing channel that involved more number of market intermediaries i.e., channel I (Producer - Pre-harvest contractor – Wholesaler – Retailer - Consumer) was found to be the most effective in the study area because 65.16 q constituting 55 per cent of the marketed surplus moved through that channel to the distant markets. The study also revealed that lack of technical know-how, high cost of establishment in the initial stage, high fluctuation in market prices and small land holding in technical, economical, storage and marketing and general constraints respectively were the major constraints faced by the farmers in Assam lemon cultivation. Regular monthly training programmes by KVKs regarding new technology, development of regulated markets, formation of FPCs, co-operatives, provision of Government subsidy on essential agricultural inputs, etc., would help to overcome the obstacles in production and marketing aspects of Assam Lemon cultivation.

## **A study on production and marketing selected high value vegetable crops in Lower Brahmaputra Valley Zone (LBVZ) of Assam**

*Dipjyoti Sarma*

The present study was carried out in Kamrup (rural) and Barpeta districts of Assam to estimate the cost of cultivation of selected high value crops, to identify and estimate the efficiency of marketing channel associated with the selected high value vegetable crops and various constraints associated with high value vegetable crops. Three high value crops were selected viz. Pumpkin, Capsicum and Bhoot jolokia on the basis of highest area under cultivation in the study area. The study showed that cost of cultivation was found highest in Capsicum followed by Bhoot jolokia and Pumpkin. It was Rs. 184348.99, Rs. 158372.05 and Rs. 89988.80 respectively. Depreciation and rental value of owned land was also highest in Capsicum followed by Bhoot jolokia and Pumpkin. Gross return was found highest in Bhoot jolokia. Bhoot jolokia showed highest benefit cost ratio followed by Capsicum and Pumpkin. It was 5.5, 2.8 and 2.4 respectively. The study of marketing for these crops in the study area identified the major marketing channels for each of the three crops. The highest marketing efficiency was found in the marketing channel (Producer Retailer Consumer) for pumpkin, capsicum and bhoot jolokia and it was estimated to be of 8.88, 13.68 and 6.83. It was due to least involvement of middlemen in this channel. The price spread of each of the crop for this channel were found to be 337.76, 532.33 and 2811.66 respectively. Presence of distant marketing channel was observed between Pumpkin and Bhoot jolokia. The major constraints that affected production and marketing of high value crops were incidence of pest and disease, lack of irrigation facility, non-availability of timely inputs, poor extension services, agroclimatic factors, high input-cost, risk of crop failure respectively. Besides this, the major constraints that affected production and marketing of high value vegetable crops were incidence of pest and diseases, poor resource base farmers, risk of crop failure respectively. From the study it can be concluded that the cultivation of high value vegetables crops can be a profitable venture for the farmers in the state. Proper transfer of technology, timely supply of inputs and provision of better market facility for these crops can uplift the socio-economic conditions of the farmers.

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**Abstract of M.Sc. thesis**

**Department: Agricultural Economics & FM**

**Major Adviser: Dr. Amvrin Baruah**

## **Production and Marketing of Betel vine in Lakhimpur District of Assam**

*Ghanudra Raj Chutia*

The deep green heart shaped leaves of betel vine are popularly known as Paan in India. The scientific name of betel vine is (*Piper betel* Linn). It belongs to the family of Piperaceae. It is cultivated intensively for the sake of its leaves, which are consumed by about 15-20 million people in the country. Betel vine leaves are commonly known as 'Pann' in Assam. Betel vine has a profound cultural value in the assamese society like many other asian communities, Betel vine with arecanut holds a significant place in the religious and social ceremonies of Assam. From serving it to the guests as a mouth freshner to offering it to God as a part of religious rituals, the role of betel vine in the daily lives of assamese community is prominent. Betel vine leaf is used as medicine for certain diseases and also used as an antiseptic. The present study was conducted in the Lakhimpur district of Assam, the economic analysis of betel vine in the district indicated that the crop feasible and economically viable. Thus, systematic evaluation holds necessary for policy implication that would boost the economics of production and marketing. Among the four marketing channel channel I (ProducerConsumer) was found to be the most efficient and producers share in consumer rupee was the highest. The major problems faced by the betel vine growers in the study area were damage by pest and diseases, high fluctuation in prices and lack of proper storage facility in the production and marketing constraints respectively.

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**Abstract of M.Sc. thesis**

**Department: Agricultural Economics & FM**

**Major Adviser: Dr. Riaz Abdul Halim**



# **Management Appraisal of Commercial Poultry Egg Production- A Case Study in Jorhat District of Assam**

*Gina Naiding*

The study entitled “Management Appraisal of Commercial Poultry Egg Productiona Case Study in Jorhat District of Assam” was undertaken during the period 2021-2022. The study was conducted to examine the status of poultry egg production in the state of Assam, analyze resource management and economic feasibility of egg production in Jorhat district of Assam as well as to study the egg consumption patterns, preferences and perceptions of consumers in the study area. The data were collected through structured interview schedule. The sampling design followed for the study was simple random sampling design. To study the resource management and economic viability of egg producing farms in Jorhat district of Assam, a case study approach was considered for three commercial layer farms of different size groups. For study of consumption patterns, preferences and perceptions of consumers in Jorhat district, 100 respondents were selected at random from areas where the commercial farms were located. The study revealed that although the egg production in Assam has been slowly increasing with a growth rate of 1.43 from 2014-15 to 2019-20, the production as well as per capita availability of the egg is still lower than most leading states in India. Among the states in NER, Assam produced the most number of eggs with 5148.75 lakh number of eggs in 2019-20 and with per capita availability of 15 eggs for the same year. In 2019-20, Assam ranked 18th in total egg production in India and contributed only 0.45 percent to the total egg production in India compared to other leading states like Andhra Pradesh (19.17 percent), Tamil Nadu (17.50 percent), Telangana (12.94 percent), and West Bengal (8.51 percent). Although Assam produced most number of eggs in NE region but the growth rate was lower as compared to other states like Tripura and Arunachal Pradesh at 1.67. It was also found that although Jorhat district ranked 5th in district wise poultry population in Assam in 2019, the growth rate of egg production was found to be negative with -7.23% from 2016-2020. Jorhat ranked 12th in total egg production of Assam in 2019-20 and the percentage share of Jorhat district to total egg production was 3.63%. From the study, it was found that among the variable cost, feed

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**Abstract of M.Sc. thesis**

**Department: Agricultural Economics & FM (MBA)**

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cost accounted for maximum cost with Rs.1108.23 per layer per year in small farm, Rs.1277.64 in both medium and large farms per layer, and Rs.1221.17 per layer for the sample as a whole in a year. For the small, medium and large farms, the proportion of fixed cost in total cost of production was 2.33 percent, 2.56 percent and 3.97 percent, respectively. The share of variable cost to total cost of production in case of small, medium and large farms was 97.67 percent, 97.44 percent and 96.03 percent, respectively. Poultry layer enterprise was found to be a profitable business at any scale of production. The return over total cost in case of small, medium, large and pooled farms was 1.15, 1.06, 1.05 and 1.09, respectively. The break-even production of egg in small, medium and large farm was found to be 1044.51, 35570.80, and 624419.84, respectively and 220345.05 number of eggs for the sample as a whole. The break-even price on small, medium, large and whole sample was Rs.1.039, Rs.1.037, Rs.1.002, and Rs.1.026 per egg, respectively. The margin of safety for egg production was 37637.84, 1133370.37, 13161462.50 and 220345.05 for small, medium, large farm and sample as a whole, respectively. Also the margin of safety for egg price for small, medium, large and whole sample was Rs.8.96, Rs.6.96, Rs.6.99 and Rs.7.63, respectively. High margin of safety proved the profitability of poultry layer business of sample farms. Under the study it was revealed that out of 100 respondents taken for study of egg consumption pattern, preferences and perceptions, only 16 percent of the surveyed population did not consume eggs and rest 84 percent were consumers of egg. Most of the consumers had an average monthly expenditure of Rs.50 - Rs.150 and mostly consumed eggs 2-3 times a week. The major reason for egg consumption was found to be due to taste followed by health properties of egg, and purchase of egg was mostly from grocery stores. Price was seen to be an important factor in influencing consumers' buying behaviour. Majority of the consumers under study preferred Bahubali over Assomi and Uttarkhongia egg. The main reason for brand preference was price followed by quality.

## **Assessment of productivity gap in rice cultivation in Golaghat district of Assam**

*Karan Chetry*

The present study aims at examining the “Assessment of Productivity Gap in Rice Cultivation in Golaghat District of Assam” was undertaken with specific objectives viz., Examine the extent of resource use and efficiency measures in rice cultivation, Estimate the magnitude of productivity gaps in rice cultivation and identify the factors required for intervention, Valuation of technological intervention required for enhancing rice productivity and explore the policy options. In order to evaluate the objectives of the study, a multistage random sampling technique procedure was adopted for fulfillment of the study. Most of the sample farmers were growing Ranjit variety of Rice crop. The study is based on primary as well as secondary sources and made use of farm level cross sectional data collected from 100 samples of farmers of different farm size groups in the crop year 2020-21. On the basis of highest percentage of area and production of Rice, two blocks from Golaghat district were selected for the present study. To calculate the cost of cultivation, efficiencies measures, yield gap, factors required for intervention, valuation of technological intervention, median and average method, frontier 4.1, yield gap estimation method, multiple linear regression and tabular analysis was used. The finding of the study reveals that average cost of cultivation was observed as Rs 34,894.08. Per hectare which varies from Rs 27,825.69 per hectare at marginal, Rs 36,653.53 per hectare at small, Rs 38,122.02 per hectare at medium and 41,844.39 per hectare at large farms. The technical efficiency for all sample farmers ranged 82.33 per cent to 98.22 per cent. The mean technical efficiency was observed to be 93.44 per cent hence; it was possible for the sample farmers to raise their yield further 6.56 per cent. The average allocative efficiency for overall size group was 92.11 per cent, with maximum and minimum allocative efficiency of 97.21 per cent and 84.22 respectively. This revealed that with proper allocation of existing resources allocative efficiency in rice production could be increased by another 7.89 per cent. The average economic efficiency for overall size group of farms was recorded to be 88.22 per cent, with maximum efficiency of 95.66 per cent and minimum efficiency of 82.34 per cent. This indicated that with proper allocation and use of inputs variables, rice production could be increase by another 11.78 per cent. It was observed that per hectare production

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**Abstract of M.Sc. thesis**

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was found at 44.20 ql., 45.20 ql., 45.00 ql., and 45.30 ql. at marginal, small, medium and large farms respectively along with the overall average of 44.10 ql., per hectare. The Research station yield (yield realized on research station farms) was found to be 65.00 quintals per hectare whereas the Demonstration farm yield of rice (yield realized at demonstration plots) was found to be 52.00 quintals per hectare and for progressive farmers it was found to be 50.00 quintals per hectare. The average yield of rice realized by the sample farmers was 44.10 quintals per hectare. Per hectare yield realized by the sample farmers was observed to be 44.20 quintals, 45.20 quintals, 45.00 quintals and 45.30 quintals on marginal, small, medium and large farms, respectively, which indicated that there was slight difference in the yield of rice obtained at different, sized farms. In case of overall farms, the gap in seed rate (kg), urea use rate (kg), MoP rate (kg) and labour use (man days) were found to be having significant effect in yield gap of rice cultivation, which indicated that the recommended package of practices was not followed by most of the farmers which led to existence of a wide gap between the progressive farm yield and actual farm yield. In order to narrow down the yield gap in rice, it was necessary to find out the factors affecting the yield gap. Based on the findings of the present study few policy implications were also suggested.

# **Economic Analysis of Potato Cultivation under Conservation Agriculture Vis A Vis Conventional Agriculture- A Study in Bishwanath Chariali District of Assam**

*Kaustabh Kishor Das*

The present study was conducted in the Bishwanath Chariali district of Assam to study the resource utilization pattern, economics of potato cultivation under conservation and conventional agriculture and problems faced under conservation agriculture of potato cultivation. The sampling design followed for the study was multistage stratified random sampling. Analysis of the data was done by using compound growth rate, simple tabular analysis, basic descriptive statistics like average and percentages, cost concepts, breakeven analysis, Garrett's ranking technique. The study revealed that there is no significant difference in the yield obtained from conservation agriculture with conventional agriculture but there is difference in total variable cost, total fixed cost and total cost of conservation agriculture with conventional agriculture. Similarly, gross return and net return were calculated and found to be different in both the methods. The study also revealed that the break even production and break even price were found to be have variations compared to the actual production and price under conservation agriculture and conventional agriculture. The results of the study also revealed that less availability of crop residues, adoption of method on large scale, incidence of animals etc., were the major problems faced under conservation agriculture. Government should take effective measures through various programmes and demonstration to cover all the farmers for encouraging them to go for adoption of conservation method of crop cultivation as it facilitates adoption of double and multiple cropping by reducing the time, energy and cost.

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**Abstract of M.Sc. thesis**

**Department: Agricultural Economics & FM**

**Major Adviser: Dr. Riaz Abdul Halim**

## **Organization and Management of Bipanan Khetra - A New Market Initiative**

*Lakhyajit Nath*

The project work was carried out for a period of three months from May-July, 2022 at the Six Mile – Panjabari area of Guwahati city, Assam to study about the organizational and management of Bipanan Khetra, A new market initiative. Bipanan Khetra is an outcome of the Assam State Agricultural Marketing Board (ASAMB) and Anjaybee Green to promote and market organic food among the people of the region. Bipanan Khetra a one-stop-shopping-experience-zone, an answer to growing health concerns of the city. People can experience the Northeast's first ever Ozone washed fruits and vegetables at Bipanan Khetra. . Anjaybee Info tech private Limited Ltd is a private limited company based in Guwahati, Assam. Bipanan Khetra established on 2015. The corporate identification number (CIN) of this company as per the official records is U72300AS2007PTC008427 and the company registration number is 8427. The office address is House no. 34, Hatigaon, Guwahati, pin 781006 For this study, a total of 100 numbers of consumers were selected. Simple random sampling design was followed for the study. Data relating to the perception of the consumer were collected from consumers with the help of a structured pre-tested schedule and questionnaire through personal interview and secondary data were collected from record book and reports of the Organization. At present, the Organization has 33 numbers of manpower including BOD. Different organic products, fruits, vegetable, rice, poultry and livestock products, value added products are available on the supermarket. Varieties of efficient marketing channels are involved in Bipanan khetra.

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**Abstract of M.Sc. thesis**

**Department: Agricultural Economics & FM**

**Major Adviser: Dr. Manashi Gogoi**

## **In vitro regeneration of banana cv. Malbhog through embryogenic cell suspension (ECS)**

*Manoj Kale*

Banana is one of the major fruit crops for global food security and the fourth most important food crop after rice, wheat and maize. It is one of the most widely consumed fruit in tropical and subtropical regions and provides income through local and international trade. The fruit is a rich source of carbohydrate (13%), fibre (7%), protein (1.2%) as well as elements such as K, Mg, Ca, Fe, vitamins, with calorific value of 67-137/100 gm. In India, bananas and plantains are being grown since vedic times and ranks first in banana production in the world. The North-Eastern region has diverse forms of indigenous banana cultivars; most common indigenous cultivated banana are under the genomic group AAA, AAB and ABB. 'Malbhog' (AAB group), is a medium tall, most preferred indigenous table banana variety (AAB genomic group) of Assam that bears fruit in 18 months, yields about 8-9 kg per bunch and high commercial value banana cultivar due to its sweet aroma, taste and highest post harvest life. However Malbhog is highly sensitive to *Fusarium oxysporum* f. sp. *cubenses* which infects the plants up to the xylem tissues, induces wilt and kills banana plants (Stover, 1962) As such conventional micropropagation through shoot tips create lots of contamination during in vitro propagation. Alternatively, embryogenic cell suspension (ECS) is the best option to generate disease free quality planting material of Malbhog. In the current study we established ECS from immature inflorescence of male flowers of Malbhog to generate large scale disease free quality planting material. The modified MS (Murashige and Skoog, 1962) medium supplemented with various combinations and concentration of growth hormones were utilized in the present investigation. Attempts were first made to initiate somatic embryogenesis from immature male inflorescence. White translucent pro-embryogenic calli was used for establishment of ECS. The different modified media used in the current study are M1 (Callus induction); M2 (Liquid suspension for ECS); M3 (Embryo maturation); M4 (germination of somatic embryos and shoot multiplication) and M5 (Rooting from in vitro regenerated shoots). Highest percentage (85%) of callus induction was observed in M1 medium supplemented with 2 mg/l 2,4-D, 1mg/l NAA, 1 mg/l IAA. However, only 7.5% of the calli developed friable embryogenic calli after 6 months of culture in the same medium.

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Pro-embryogenic calli were used to establish (ECS) in M2 liquid medium supplemented with 1 mg/l 2,4-D, 0.25 mg/l Zeatin, 10 mg/l Ascorbate. ECS of 1 ml developed  $9.03 \times 10^3$  numbers somatic embryos on M3 maturation medium supplemented with 1 mg/l Picloram, 100 mg/l Glutamine and 10 mg/l Ascorbate. 80% of somatic embryos were germinated and developed shoots on transferring to M4 medium supplemented with 4 mg/L BAP and 100mg/L myoinositol after 2 months of culture. In vitro regenerated shoots developed roots (95%) in M5 medium supplemented with 2 mg/l IBA after 1 month of culture. In vitro regenerated Malhbug plantlets successfully hardened and showed 100% survivability in the net house.



## **Economic analysis of flood tolerant rice varieties as a risk mitigation strategy adopted in North BankPlain Zone (NBPZ) of Assam**

*Monuj Pegu*

Flood is a havoc to farmers especially rice growers of Assam as sali rice is grown in a season threatened by flood. International Rice Research Institute, Philippines and Central Rice Research Institute (CRRRI), Orissa released few Flood Tolerant Rice Varieties for the flood affected rice area of the nation. In Assam, RARS, Titabor has released two varieties Ranjit Sub1 and Bahadur Sub 1 for the submergence areas of Assam. In many farmers field, demonstrations are going on for the performance of these varieties under the supervision of the KVKs. In Dhemaji and Lakhimpur district, some farmers have been growing Swarna Sub- 1, Ranjit Sub-1 and Bahadur Sub-1 in their fields. However, all the flood affected rice growers are yet to adopt the flood tolerant varieties in their fields. In this study, an attempt was made to examine the status of adoption of flood tolerant rice varieties in the district. With more educated farmers and more extension contacts, the adoption of flood tolerant rice varieties was found to be increased. Although the cost of cultivation of flood tolerant rice varieties was comparatively more than normal rice varieties. Due to yield advantage the return over cost was more in flood tolerant rice varieties. The overall cost of cultivation per hectare for flood tolerant rice varieties was Rs. 31,477.02/ha and for normal rice varieties was Rs. 29,609.50/ha, respectively. The gross returns obtained from rice flood tolerant varieties were Rs. 39789.12/ha which was slightly higher than normal rice varieties i.e. Rs. 35906.69/ha. The return over cost ratio for the normal rice varieties and flood tolerant rice varieties was found to be 1.26 and the 1.29. From the findings of the study, it is evident that the propensity to adopt flood tolerant rice varieties by farmers increases with the level of education of the farmers (significant at 10%). Other factors which play significant role in adoption of flood tolerant rice varieties are contact with extension personnel (significant at 5%) and bearing proper knowledge of package of practices (significant at 5%). The factors which create problem in association with adoption of flood tolerant rice varieties (FTRV's) in the study area were ranked in an order from

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high to low as –high cost of seed, pests and diseases, untimely supply of seeds, flood water with water hyacinth, inadequate finance, inadequate supply of seed, lack of awareness about flood tolerant rice varieties, extension personal contacts.

## **Determinants of adoption of recommended khasi mandarin production practices in Assam**

*Nabanita Borah*

Citrus is a vast genus of fruits that belongs to the Rutaceae family. Khasi Mandarin is an extensively produced and commercialised mandarin variety grown in India's north-eastern area. In 2015-16, Assam's total orange production was 210141 tonnes, with an area of 15649 hectares and a yield of 13428 kg per hectare. Despite the availability of new varieties, a more comprehensive set of procedures, scientific technology, and conventional orchard management, the mandarin orchard continues to suffer. Farmers' failure to embrace or inadequate adoption of recommended mandarin practices could be the reason for the low production of mandarin. The present study is an attempt to study the extent of adoption level of recommended Khasi Mandarin production practices and analyses the factors affecting adoption of the recommended practices. The study also explores the problems faced by the farmers in adoption of recommended practices. The study was conducted in Kamrup rural and Kamrup metropolitan districts of Assam. A multistage random sampling technique was followed to select the ultimate sample unit of 120 farmers. The result of the study revealed that growth rate of area under mandarin for Kamrup rural, Kamrup metropolitan and Assam was found to be significant and positive over the time period 2007-2019, i.e., 9.74, 5.65 and 5.60 per cent per annum, respectively. Growth rate in production of mandarin for Kamrup rural, Kamrup metropolitan and Assam was also recorded to be positive and significant, i.e., 10.87, 4.45 and 8.29 per cent per annum, respectively. And growth rate of productivity of mandarin for Kamrup rural district and for the state of Assam was recorded to be positive and significant i.e., 1.03 and 2.54 per cent per annum, respectively. Whereas, the growth rate for productivity of mandarin for Kamrup metropolitan district was found negative and significant, with a value of -1.13 per cent per annum. Out the two districts, Kamrup rural showed maximum variability in area (23.88 %) and production (25.33 %) whereas Kamrup metropolitan showed maximum variability in productivity (8.20 %). For Assam maximum variability was found in area under Khasi Mandarin (14.97 %). And 12.10 per cent variation in production followed by 4.86 per cent in productivity. During the period, area effect was the most responsible factor for changing production in Kamrup rural, Kamrup metropolitan and Assam i.e.,

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85.75 per cent, 128.89 per cent and 63.98 per cent, respectively. The total cost per hectare per year for pooled farms was Rs.36113.66, Rs.39459.73, Rs.39897.30, and Rs.40350.03 for the year 6<sup>th</sup>, 10<sup>th</sup>, 15<sup>th</sup> and 20<sup>th</sup>, respectively. Gross returns per hectare 7 per year from pooled farms for the considered years were found to be Rs.118561.70, Rs.138124.80, Rs.154565.10, and Rs.166308.20, respectively. Net return for the farm was obtained by deducting total cost per year from gross return per year, which was calculated to be Rs.82448.05, Rs.98665.12, Rs.114667.80, Rs.125958.20 for 6<sup>th</sup>, 10<sup>th</sup>, 15<sup>th</sup> and 20<sup>th</sup> year. Benefit cost ratio for the pooled farm was calculated to be 3.35 per cent, NPV was found to be Rs.727830.86 and IRR was calculated to 38.91 per cent, which indicates cultivation of mandarin in the study area is economically feasible and profitable. For calculating the adoption level adoption index was calculated and farmers were categorized into three groups viz., low, medium and high adopters by using mean and standard deviation. For analyzing the factors affecting adoption of recommended practices logistic regression model was used. In the study 12 practices recommended by Assam Agricultural University in package of practices was considered. And the constraints faced by mandarin growers were group under four categories viz., technical, economic, storage and marketing and general constraints. The ranking of problems in each category was done by using Henry Garret ranking method. The study found that majority of farmers belongs to medium adopter (71.67) category followed by low adopters (15.83) and high adopters (12.50). Planting materials, weed management, and harvesting practices were found to be highly adopted by the sample farmers, whereas irrigation, disease, and post-harvest management strategies were found to be lowly embraced. And the study shows that major problems faced by mandarin growers are disease sensitivity of the crop, operations are labour intensive, marketing prices of the produce fluctuate highly and unavailability of proper roads. So, awareness and training to the farmers about recommended practice, arranging supply of quality planting materials, providing subsidies on inputs, appointment of more extension workers and their regular training in concerned department about up to date technical know-how, establishment of storage structures and preservation industries etc., can help the farmers of the study area to tackle their day to day problems in cultivation procedures and also converting that medium adopter group into high adopters.

# **Dynamics in Growth and Development of Horticulture Sector in Assam: An Economic Analysis**

*Nidhishree R*

Performance of the horticultural sector of the state Assam was found in this study. The area, production and productivity of onion in the State Assam were set up to be increasing, meanwhile the growth rate of arecanut was quite disappointing. The Compound Annual Growth Rate of area, production and productivity of major horticultural crops grown was also calculated zone wise. It was observed that, even when the area under cultivation of most crops had been decreasing for years, the production and yield of crops were seen increasing in the BV zone. HZ was the only zone where cultivation of most of the considered crops was found to be good. The dispersion of area, production and productivity of fruit crops, vegetable crops, tuber crops, spices and plantation crops was also calculated using coefficient of variation for the state. Zone wise variation was also found for few important horticultural crops. The probability of change in the area under horticultural crops was calculated using Markov chain technique, it was found that the probability of retention of area under kharif and rabi vegetables was high. The retention of area under arecanut was 79.4% which was comparatively better than coconut. Under spice crop onion was having higher retention capacity. It was observed that Farmers were more interested in cultivating orange and Assam lemon and also noticed that the change in area from pineapple to banana and also from mango to banana was found to be high. With subject to tuber crops, the retention capacity was the highest for potatoes. The change in production was found using decomposition analysis. The pattern of diversification of horticulture in Assam was found using Simpson's Diversification Index, and found that there was better diversification in horticulture farms. The contribution of the horticultural sector to the GSDP and GSAV at both current and constant prices was calculated using simple percentage analysis. Among all, fruits and vegetables were found to be contributing more to the state's economy.

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# **An Economic Analysis of Factors and Constraints of Production and Marketing of Major Spices in Assam**

*Niharika Borbaruah*

Spices are generally considered as high-value crops that can be included in the farm plan to generate additional revenue in addition to the staple food crops. The climatic condition of Assam is very much suitable to grow a variety of spice crops. The present study entitled “An Economic Analysis of Factors and Constraints of Production and Marketing of Major Spices in Assam” was conducted under two different agro climatic situations representing plain and hill zones. Two districts, Karbi Anglong, a hill district and Jorhat, a plain district were selected for the study. The study was designed to examine the trends in area, production and productivity of spices using the exponential form. Over years data pertaining for the period 2005-06 to 2019-20 on area, production and productivity for important spices were collected and analysed for growth rates. Cobb-Douglas Production Function and Multiple Linear Regression equations were used to examine the factors influencing production and marketing of spices, respectively. The study also examined the different marketing channels, price spread and marketing efficiency using various market concepts. Furthermore, the constraints in production and marketing in both the districts were studied separately based on growers' perceptions. The trends in area, production and productivity of ginger, turmeric, chilli, black pepper, coriander and garlic were examined for the state of Assam and both the districts. A positive and significant growth rates were found in area, production and productivity of ginger, turmeric and chilli in the state and both the districts. However, a negative trend was found in area and production of black pepper in Jorhat district. Coriander productivity in Assam was also found to be negative, which could be attributed to factors such as a lack of technological advancements and the use of high yielding varieties. Furthermore, a negative growth was found in garlic's production and productivity in Karbi Anglong and area in Jorhat, respectively. The significant factors affecting production of ginger and turmeric in the hill district were operational land and human labor and while factors affecting ginger production in the plain district were operational land and seed rhizome. The significant factors affecting production of

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turmeric in the plain district were operational land, human labor and capital at disposal. However, credit use had a significant and negative effect on production. Operational land and human labor had a positive and significant effect on chilli production while use of plant protection chemicals had a negative effect. Production kept for home consumption and seed rhizome had a significant and negative impact on marketable surplus in all the crops of the regions. However, in case of turmeric in the hill district, selling price had a significant positive impact on marketable surplus. Furthermore, post-harvest cost of turmeric in the plain district had a significant negative impact on marketable surplus. The study of marketing of spices revealed that the different marketing channels of ginger in the hill district include: Producer → Local/Itinerant Trader → Wholesaler → Retailer → Consumer and Producer (through Growers Cooperatives) → Wholesaler → Distant Market, while the different marketing channels of ginger in the plain district include: Producer → Wholesaler → Retailer → Consumer and Producer → Retailer → Consumer. The different marketing channels of dried turmeric in the hill district include: Producer → Wholesaler-cum-Processor → Retailer → Consumer and Producer (through Growers Cooperatives) → Wholesaler-cum-Processor → Distant Market while the different marketing channels of dried turmeric in the plain district include: Producer → Wholesaler-cum-Processor → Retailer → Consumer and Producer → Retailer-cum-Processor → Consumer. The different marketing channels of chilli include: Producer → Retailer → Consumer and Producer → Wholesaler → Retailer → Consumer. Also, the different marketing channels of black pepper include: Producer → Retailer → Consumer and Producer → Local Trader → Wholesaler → Distant Market. Marketing efficiency of 9.75 (only up to wholesale level) was found in channel II of ginger in hill district and Channel II (7.91) in plain district was found to be more efficient. In case of dried turmeric, marketing efficiency of 14.66 (only up to wholesale level) was found in channel II in hill district and Channel II (9.22) in plain district was found to be more efficient. Channel I was found to be more efficient in case of chilli (3.36) and black pepper (3.19), respectively. The major constraints that affected production and marketing of ginger and turmeric in the hills were low adoption of better and improved production practices and technology and presence of middlemen/ local traders respectively while the major constraints that affected production and marketing of ginger and turmeric in the plains were unfavourable weather conditions and poor market infrastructure respectively. The major constraint in the production of chilli and black pepper was high cost of cultivation while the major constraint pertaining to marketing of chilli and black pepper was low selling price in the local and distant market during the peak time.

## **A study on the economic aspects of the small tea growers in Dibrugarh district**

*Pahari Saikia*

The present study entitled “A Study on the economic aspects of small tea growers in Dibrugarh district” was conducted with the objectives to study the pattern of resources, returns and efficiency of resources in tea production. Random cum proportionate sampling was followed for selection of estates. A total of 120 sample estates were selected from two development blocks, i.e., Barbaruah and Khowang Development Blocks. The small tea growers were classified into mini, mid-size and mega estates according to the land holding size of 0-11 bigha, 11-30 bigha and above 30 bigha, respectively. The results of the study revealed that total operational holding of the sample estates was 19.58 bigha of which 18.38 bigha of land was under tea cultivation and only 1.20 bigha of land was used to produce other crops or kept fallow. The land used for cultivation of tea for mini, mid-size and mega estates were 5.23 bigha, 18.38 bigha and 49.45 bigha, respectively, which showed that as the size of the holding increased, the proportion of land under tea cultivation also increased.

The types of resources used were manure, fertilizers (urea, Single Super Phosphate (SSP) and Muriate of Potash (MOP)), plant protection chemicals and labour which include the mandays of male and female labour and machine hour. It was found that sample estates were mostly dependent on fertilizers than on organic manures. Due to limited knowledge of plant protection measures, arbitrary doses of chemicals were applied rather than the recommended doses. Both male and female mandays increased per estate and decreased per bigha with increase in the size of estates from mini followed by mid-size and mega estates. However, the demand for female labour was comparatively high in all the estates due to their lower wages and involvement in major operation of plucking and weeding, implying a better livelihood for the rural women. Higher machine labour was used by mega estates indicating adoption of modern technologies was maximum in this category as compared to mini and mid-size estates.

It was observed that total cost of cultivation for mini, mid-size and mega estates was ₹14,779.86, ₹13,942.89 and ₹13,478.83, respectively, which varied directly with the land size of small tea growers. It was found that highest per cent of the total variable cost composed of the costs of fertilizers which alone contributed 48.94 per cent of total

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cost followed by labour. This indicated that tea cultivation is both fertilizer and labour intensive. The examination of farm management efficiency parameters of tea cultivation indicated that all the size categories the benefit-cost ratio was greater than unity which further indicated that the benefits outweighs the costs in the estates. Both gross and net returns in tea estate increased with the increase in the size of estates. The four significant variables positively influencing tea yield were land, fertilizer, female and male labour with elasticity co-efficient 1.001, 0.031, 0.117 and 0.108, respectively. Among all the variable inputs, the influence of seedling, FYM and machine labour on output was seen to be non-significant. It was observed that 90.6 per cent was technically efficient and the remaining of 9.4 per cent technically inefficient. It was observed that low price realization of tea leaves, lack of workers in the peak plucking season, lack of technical knowledge, incidence of insects, pests and diseases and high price fluctuation of green tea leaves were the common problems faced by the small tea growers in the study area.

# **Assessment of productivity gap in rape and mustard cultivation in Kokrajhar district of Assam**

*Phami Basumatary*

The present investigation entitled, “Assessment of productivity gap in rape and mustard cultivation in Kokrajhar district of Assam” was undertaken with following objectives viz., to examine the extent of resource use and efficiency measures in rape and mustard production, to estimate magnitude of productivity gaps in rape and mustard cultivation and identify the factors required for intervention and valuations of technological intervention required for enhancing rape and mustard productivity and explore the policy options. Being one of the largest rape and mustard growing districts of Assam, in term of area of cultivation, Kokrajhar district was selected for the study. Two blocks namely Titaguri block and Gossaigaon block were randomly selected from the district. In the next stage, a total of four villages, i.e., 6 No. Basbari and Brahmapur villages from Titaguri block and Saraibil and Kachukata villages from Gossaigaon block were selected at random. At the last stage, 25 farmers from each village were randomly selected forming the primary data of 100 sample farmers. The framers were then categorised into marginal (< 1 ha), small (1-2 ha), medium (2-4 ha) and large (>4 ha) based on their land holdings. Secondary data were collected from the publication, Impact of Technologies on Oilseeds Production in North Eastern Region and Krishi Vigyan Kendra, Kokrajhar. The findings revealed that the sample farmers did not follow proper package of cultivation practices for rape and mustard. The results showed that the average cost of cultivation was estimated to be Rs. 29539.18 per hectare, which varied from Rs.26294 to Rs. 32711.39 per hectare. The results indicated that technical, allocative and economic efficiency of farms were respectively 94.23 percent, 90.83 percent and 87.72 percent on average. The yield gap analysis recorded 6.48 q/ha yield gap between the research station yield and average farm yield, 3.38 q/ha yield gap between demonstration yield and average farm yield and yield gap of 3.10 q/ha between progressive farm yield and average farm yield. The index of realized potential farm yield-II was estimated to be 64.03 percent on an average. Regression analysis showed that the gaps in input used between progressive farms and the sample farms needed to be

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reduced in order to narrow down the yield gap. In order to reduce the input gaps, farms needed to invest more on their inputs. The results of valuation of technical intervention showed that smaller farms had to invest more in inputs than the larger farms in order to increase their rape and mustard yield.

## **An Economic Analysis on Contribution of Women in Farm Business – A study in Dhemaji District**

*Priyanka Chutia*

The study entitled ‘An Economic analysis on contribution of women in farm business- A study in Dhemaji district’ was conducted with the following objectives:

1. Study the contribution of women in farm and non-farm activities in the study area
2. Work out the gender differential in labour utilization in farming and allied activities
3. Working out the physical and economic conditions under which a farm women works and to explore their potential in enhancing the farm family income
4. Elicit the opinion of the farm women to overcome the problem of unemployment during off season

Dhemaji district of Assam was selected purposively in carrying out the present investigation. A multistage random sampling method was adopted in selection of 120 respondents which constituted the sample for the study. From the selected district two blocks Dhemaji and Machkhowa were selected purposively. From each selected block three villages were taken randomly thus making a total of six villages. The major tool used for collection of primary data in the study was a pretested schedule by personal interview method. For the purpose of achieving the specific objectives of the study data collected were subjected to the statistical analysis. For this purpose tabular presentation method with averages, frequency and percentages were employed. Transplanting and harvesting accounted for the highest proportion of women labour utilized in crop cultivation. During transplanting, on an average women workers devoted 37.24, 33.75, 49.43 and 44.28 mandays in marginal, small, medium and large households, respectively. In harvesting operation, the sample women devoted 32.95, 33.74, 48.11 and 47.93 mandays in the marginal, small, medium and large farm households, respectively. In livestock management the highest women labour was utilized in cleaning shed/utensils, milking, preparation of food/feed and watering animals in the pooled sample. The average mandays devoted by women in cleaning sheds or utensil was 45.97, 71.44, 61.18 mandays for the small, medium and large households, respectively. The average mandays devoted by women in milking was 64.16, 39.64, 49.94, and 28.31 for marginal, small, medium and large farm households, respectively. Preparation of feed is another important task done mainly by women in which the

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devotion of women on an average was 26.13, 37.30, 50.68 and 59.77 respectively. The average mandays devoted by farm women in the non-farm sector was highest in the handloom industry with an average mandays of 113.83, 95.92, 69.06 and 49.56 for marginal, small, medium and large farm households, respectively. Across the size groups the total male family labour utilized were 119.90, 134.31, 182.92, 177.32 mandays in the marginal, small, medium and large farm households, respectively. The total female labour utilized were 88.74, 97.22, 142.99 and 118.66 mandays in the marginal, small, medium and large farm households, respectively. In livestock management, total male labour utilized were 92.05, 127.81, 88.99 and 66.13 mandays against 149.18, 192.46, 194.69 and 160.78 mandays of female family labour in the marginal, small, medium and large farm households, respectively. The total male labour utilized in non-farm activities were 73.48, 85.40, 115.11 and 123.21 mandays against 151.07, 181.95, 156.26 and 147.87 mandays from female family labour in marginal, small, medium and large farm households, respectively. Activity wise participation of women in craftwork was much higher than men and the average mandays devoted by them were 113.83, 95.92, 69.06 and 49.56 for the marginal, small medium and large farm households, respectively. In the study area most of the households lived in pucca or semi pucca houses. Economically weaker households received housing facilities through Pradhan Mantri Awas Yojana. Women generally worked throughout the day on field in peak agricultural season from March-April to November-December in the study area. They spent their time doing farm related works in their own field as well as in the neighbouring fields. Few women were engaged as hired labours having smaller land holdings. On an average about 86.49 per cent of income was generated from the farming and allied sector and only 13.50 per cent was generated from the non-farm sector. It can be said that the livelihood pattern of the people of the study area was mainly dependent on agriculture and allied activities. It was found that the annual income per farm increase with the farm size which indicates a positive relationship with the size of land holdings.

## Performance of Agricultural Exports in India

*Ramagiri Mamatha*

The goal of the current study was to evaluate performance of agriculture exports from India during the 1990–1991 to 2019–2020. The entire study period was divided into three decades: decade I (1991-2000), decade II (2001-2010), decade III (2011-2020). Secondary data on the exports of Agricultural commodities were mostly gathered from the Directorate General of Commercial Intelligence and Statistics (DGCIS), APEDA, Ministry of commerce and several official websites. The study shows that, in the decade I commodities like Basmati rice, Non-basmati rice, Ground nut, Pulses, Castor oil, Sesame seeds registered very high(>10) growth rate. Tobacco, Fruits/Vegetable seeds, Spices registered high (10-5) growth rate. Cashew kernel, others registered medium (2-5) growth rate, tea registered low(0-2) growth rate, Sugar, Oil meals, Wheat, Cotton, Guar gum, Cashew nut shell liquid, coffee registered negative(<0). In the decade II commodities like Basmati rice, Ground nut, Tobacco, Oil meals, Spices, Castor oil, Cotton, Guar gum, Cashew nut shell liquid registered very high growth rate, Fruits/Vegetable seeds registered high growth rate, Marine products, Sesame seeds, others registered medium growth rate, Cashew kernel, tea registered low growth rate, nonbasmati rice, Sugar, Pulses, Wheat, Shellac, Coffee registered negative growth rate. In the decade III, commodities like Basmati rice, Non-basmati rice, Sugar, Fruits/Vegetable seeds, Spices, Castor oil, Marine products, Shellac registered very high growth rate, Pulses registered high growth rate, Tea, Guar gum, Cashew nut shell liquid, others registered medium growth rate, ground nut registered low growth rate, Tobacco, oil meals, Wheat, Sesame seeds, Cotton, Coffee registered negative growth rate as indicated by the CAGR. Share of Agricultural exports to total exports was declined during 1990- 1991 to 2019-2020. Commodity wise shares are high in commodities like basmati rice, non basmati rice, tea, spices, cashew kernel and fruits/vegetables at decade I, II, and III. Export destinations were studied for top ten destinations in Basmati rice, non basmati rice, sugar, pulses, wheat, sesame seeds, guar gum, cashew nut shell liquid, spices, ground nut, fruits/vegetables, others among decade I,II and III. Top ten destinations at three decades were found to be more or less same with little changes in their positions for certain commodities. Changes in direction of trade are calculated with the help of net shift percentage (Huff and Sherr, 1965) formula. During decade I,

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diversification was more in non basmati rice, sugar, tea, shellac, cotton, guar gum, cashew nut shell liquid, others. At decade II, diversification was more in basmati rice, ground nut, cashew kernel, fruits/vegetables, pulses, wheat, spices, castor oil, marine products, and coffee. At decade III, diversification was more in tobacco, oil meals, sesame seeds and wheat was registered least diversification. Hence, it was concluded that overall agricultural exports are comparatively declining.

## **A study on Production and Marketing of Ginger in Churachandpur district of Manipur**

*Rubindro Waikhom*

The present study was carried out in Churachandpur district of Manipur to study the cost and returns structure, the process of marketing and the constraints related to production and marketing of ginger. Shifting cultivation, commonly known as jhum is the dominant mode of food production in the study area. Ginger is cultivated as a cash crop in jhum hills spread across the entire study area. From the study, it was found that human labour was the only major source of workforce available in the study area. Machinery and bullock labour could not be used efficiently due to the uneven and rugged terrains. The use of fertilizers and plant protection chemicals was negligible. Fixed cost accounted for only 3.48 per cent of the total cost. The total cost per ha had an inverse relationship with the size of land holding. Similarly, the gross returns per ha and net returns per ha were found to have an inverse relationship with the size of land holding. Ginger cultivation is found to be profitable as the B:C ratio was 2.13. The mean technical efficiency for all farms was estimated to be 0.9438. Family labour, hired labour, seed and mulch were the significant variables positively contributing towards the yield of ginger. The study of marketing of ginger in the study area identified four major marketing channels, viz., Channel-I (Producer-Wholesaler-Retailer-Consumer), Channel-II (Producer-Village merchant -Retailer-Consumer), Channel-III (Producer Retailer-Consumer) and Channel-IV (Producer- Wholesaler-Distant market). Largest quantity of the total ginger was disposed off through Channel-IV. Channel-III had the highest marketing efficiency as it had the least intervention with middlemen. The major constraints related to production and marketing of ginger in the study area were high cost and lack of quality planting materials, high incidence of pest and disease infestation, low level of technical knowledge, dependence on middlemen for disposal, lack of market intelligence and lack of proper storage facilities. Besides these, other constraints identified were lack of suitable government policy, lack of proper transportation facilities and delayed credit facilities.

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**Abstract of M.Sc. thesis**

**Department: Agricultural Economics & FM, BNCA**

**Major Adviser: Dr. H.K. Changmai**



# **Cold Storage Management: Performance and Prospects in Assam**

*Avijeet Borah*

India has been an agrarian economy with 55 percent of its population deriving its livelihood from agriculture and its allied sectors. A cold storage is a commercial facility for storing perishable products such as fruits, vegetables, meat, fish etc. under controlled conditions for longer periods. The total capacity of refrigerated warehouses worldwide was 616 million cubic meters in 2018, 2.67% greater than the capacity reported in 2016. India was the single largest country with a cold storage capacity of 150 million cubic meters, followed by the United States at 131 million cubic meters, and China at 105 million cubic meters in 2018. The present study entitled “Cold Storage Management: Performance and Prospects in Assam” highlights the status and performance, the management practice and strategies, perception of farmers. Total 3 numbers of cold storage units were selected based on availability of information. Results from the analysis revealed that Assam has 40 cold storage unit with a total install capacity of 1, 98,871 metric tonnes (MT). The selected cold storage units are Kharupetia Cold Storage, Darrang, Raj & co, Guwahati and N.E. Cold Storage Pvt. Ltd, Guwahati. The proper management techniques and strategies establish an important relationship between production, scheduling, and shipment planning. The results have also revealed that the farmers’ perception towards cold storage units various data regarding area, production, productivity, marketable surplus, total quantity stored in cold storage units, hindrance, constrain towards cold storage loan, reasons for storing and not storing.

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**Abstract of M.Sc. thesis**

**Department: Agricultural Economics & FM (MBA)**

**Major Adviser: Dr. R.K.Sarma**

## **Demand - Supply management of fish markets in Lakhimpur district of Assam**

*Dhrubajyoti Kakati*

From a long time, fish production has been a part of the farming community for profit generation. In the modern agricultural economy, fish is a major source of income because everyone considers fish as a better animal protein source. Now a days, fish come to consumers from various sources through a long distribution channel. So, demand-supply management is an integral part of a fish market. The present study was carried out in the Lakhimpur district of Assam and the topic for the study was-“Demand-Supply management of fish markets in Lakhimpur district of Assam”. From the study, it is turned out that there is still a shortage of fish in the district. The actual per capita consumption is more than the state average and the ICMR recommendation. Study shows that the majority of sellers sell Rohu from Indian major carp, Common carp from Exotic carp, Bhangun from Minor carp, Sol from live fish, Borali from Other big variety fish, Mowa from Small variety fish and Rohu from Imported fish (local name is Chalani). It is also seen that the Majority of sellers sell between 26-50 kg/daily and they bought both local and chalani fish from wholesalers but not caught by their own. The present study shows that most adult from the family prefers fish, consume fish for 1-2 days/week and purchase 500 g or less than 500 g fish at once. The majority of the respondents said that they consume or buy fish because they know fish is a healthy source and they prefer to buy it from the local market. Other major reasons for buying fish are taste, religious reasons, etc. The majority of consumer's first preference is Rohu from Indian major carp, Common carp from Exotic carp, Bhangun from Minor carp, Magur from live fish, Chitol from Other big variety fish, Mowa from Small variety fish and Rohu from Imported fish. The high price for good quality fish is the major reason for less consumption of fish. The results have also clarified that consumers mostly identify the quality of fish by seen gill of fish and they said that they mostly know about the vitamin content of fish but they don't know about omega-3 of fish which is an essential fatty acid of fish. The major problems for retailers are Lack of proper transportation from source to market, Lack of storage facility, Low price and price fluctuation, Lack of govt. support/assistance, Poor market infrastructure, High

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**Abstract of M.Sc. thesis**

**Department: Agricultural Economics & FM, (MBA)**

**Major Adviser: Dr. C. Hazarika**

heterogeneity in size and weight among each fish type, Irregular supply of preferred fish from the source. The problems should be solved by making a good partnership between sellers and Govt. which leads to successful demand-supply management of fish in the market.

# **Risk Management in Agribusiness: An Empirical Study in Assam**

*Payel Mazinder Boruah*

Agribusiness is a sector which encompasses all economic activities related to farming *i.e.* breeding, production, manufacturing, distribution, storage, processing, marketing and sales. It is a means to raise the added value of raw materials, enhance rural economies, improve food security and nutrition, raise the standard of living in many homes that are vulnerable to exclusion. The present study focused on the wide range of sources of risk encountered in the agribusiness enterprises of the Jorhat district of Assam and the management strategies adopted to mitigate these risks. The first step in the study was to prepare a questionnaire/schedule. It consisted of socio-economic information of the respondents and also about 57 risk variables and management strategies. These variables were identified based on references from research publications and inquiries of the respondents. A sample of 100 agricultural entrepreneurs was selected which were then categorized into four groups of different entrepreneurs proportionate to size using stratified random sampling based on types of enterprises. They were selected in consultation with the District Agriculture Office, Jorhat. These 100 entrepreneurs comprised of 46 crop producers, 28 livestock rearers, 15 food processors and 11 weavers. Responses for the risk variables were recorded using the 5 point likert scale with 5 denoting “strongly agree”, 4 as “agree”, 3 as “neutral”, 2 as “disagree” and 1 meant “strongly disagree”. To determine the major risks faced by the agricultural entrepreneurs, the mean score for each variable was found out with respect to all the respondents and also for all the categories of enterprises separately. These risk variables were classified into four dimensions using principal component extraction method with varimax rotation. Then regression analysis was used to analyse the effect of identified risk dimensions on overall risk. The relationship between the dimensions was identified using correlation analysis. All these analysis was carried out using SPSS and excel. Ranking was performed to determine the management strategies adopted by them and recommendations were made to reduce the risks in light of the results seen. According to this study, there are four types of risk dimensions: marketing and institutional risk, financial and environmental risk, operational risk, and production risk and to minimize the effect of these risks, they primarily adopted diversification, direct sale, credit management, maintaining reserves of input and produce, value addition etc.

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**Abstract of M.Sc. thesis**

**Department: Agricultural Economics & FM (MBA)**

**Major Adviser: Dr. Nivedita Deka**

# **Status and Management Performance of Kotturu Tribal Farmers Services Producer Company Limited**

*Pedada Manoj Kumar*

Agriculture had been a crucial sector of the Indian economy. Agriculture provides a living for over 58% of India's population. In FY20, agriculture, and allied sectors were predicted to have contributed a total of Rs. 19.48 lakh crore. The vast majority of cultivators in India were small and marginal farmers. More than 85% of operational holdings were less than or about two hectares in size, with 66% being less than one hectare. The current study, entitled "Status and management performance of Kotturu Tribal Farmers Services Producer Company Limited," was carried out in the Srikakulam District of Andhra Pradesh during 2021-22 to analyse the performance of various operations. The data were collected from a sample of 80 randomly selected farmers, 40 of whom were FPC members and the remaining 40 were non-FPC members. Tabular analysis, ratio analysis, inferential statistics, Heckman's selection method, and Garrett's ranking approaches were used to analyse the data. The study's key findings revealed that the financial performance of the selected FPC was determined to be poor from its beginning, and these losses were recovered by the funds received from ALC (Access livelihoods Consulting India limited). Members of the FPC were unaware of digitization techniques that save time, money, and energy. This must be addressed by conducting capacity-building programmes to develop computer-based skills and knowledge. Farmers' engagement in FPC can increase their revenue.

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**Abstract of M.Sc. thesis**

**Department: Agricultural Economics & FM (MBA)**

**Major Adviser: Dr. Ramen Kumar Sarma**

## **Organizational Structure and Business appraisal of Manipur Development Society**

*Prameshori Khwairakpam*

The Manipur Development Society is a Semi Government Organization set up in 1982 under the Planning Commission of India as a Pilot project. The Society took up income generating activities in the field of Handloom, Agriculture and Misc Engineering Works right from the beginning. But due to non release of funds, all activities under agriculture & miscellaneous engineering works stopped functioning since 2015-16. However, inspite of non receipt of grant-in-aid the society continued to carry forward its business activities with the revolving fund created out of the income earned from the sales of handloom goods. As such the present study is limited to handloom sector only. The study was undertaken to see the organizational set up and functioning of Manipur Development Society, to examine the Society's business activities and also to have an insight into the problems and prospects confronted by the Society. The study was based mostly on the secondary level data. And as per records, the employment to as many as 56 regular office functionaries handling handloom production and marketing. The salary of the officials are paid by the State Government. Society also employs 11 supervisors who supervise the Handloom Production Centres spread across the state. Presently there are 41 weavers engaged in the Handloom Production Centres. The salary and wages of the supervisors and the weavers are met from the income generated from the sales of the handloom products. Internally the analysis of relevant data indicates that the compound growth rate in terms of volume of cloths produced and sales during 2012-13 to 2019-20 was found to be declining over the years which is mainly due to non release of funds for by the government business activities of the society. A large number of Handloom Production Centres are also not functioning and is one of the major causes of increase in expenditure of the Society. During financial year 2019-20, the Society produced 7563 pieces of handloom products which generated a net profit of Rs 2,65,116.70. Rani fee (traditional Manipuri chaddhar) found to be the most profitable product among the different handloom products for the year 2019-20. Some of the major problems faced by the society are lack of funds, lack of promotional activities, migration of weavers etc. It is factually true that there is a

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**Abstract of M.Sc. thesis**

**Department: Agricultural Economics & FM (MBA)**

**Major Adviser: Dr. Anup Kumar Das**

great potential for growth and development of handloom sector in the state and beyond, and if realized, it can fetch handsome profit can be generated from the handloom products. So there is a need for Government intervention for the revival of all society business activities. The society should focus more on production of products which are high in demand and on promotional strategies in order to increase the sales.

## **A Study on the Management of Sankar Azan Agro Producer Company Ltd. - A Farmer Producer Company in Nagaon District of Assam**

*Subham Goswami*

A producer company is basically a corporate body registered under Companies Act, 2013. Its main activities consists of production, harvesting, processing, procurement, grading, pooling, handling, marketing, selling, export of primary produce of the members or import of goods or services for their benefit. It also includes, promoting mutual assistance, welfare measures, financial services, insurance of producers or their primary produce. The present project work entitled “A Study on the Management of Sankar Azan Agro Producer Company Limited- A Farmer Producer Company in Nagaon District of Assam” was carried out to identify and examine the management aspects of the FPC and to evaluate the impact of the FPC on the income of their member farmers. The FPC was selected purposively on the basis of availability and accessibility. The data were collected from the FPC as well as their member farmers to analyze and to achieve the objectives of the proposed study. Shankar Azan Agro Producer Company Ltd is a private limited company incorporated officially on 28/11/2016. The corporate identification number (CIN) of this company as per the official records is U01100AS2016PTC017663 and the company registration number is 071663. The office address is M Azad Road Barabzar, Ward no 14, Nagaon, Assam, India, 782003. The results of the investigation shows that the FPC was well organized with organizational hierarchy. The study examined that the expenditure incurred for the year 2020-2021 was Rs. 46,09,719/-. The total revenue generation for the year 2020-2021 was Rs. 50,61,000/-. The profit for the year 2020-2021 was Rs. 4,51,281. The production and productivity for all the crops of the farmers were observed to be increased after joining the FPC. The gross return, the net return and the net return over variable cost were increased after the farmers joined the FPC. The study revealed that Sankar Azan Agro Producer Company Limited was earning a minimum level of profit, thus bringing a positive change in the income of the member farmer. The major problems faced by the company was high requirement of funds in raw produce

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**Department: Agricultural Economics & FM (MBA)**

**Major Adviser: Dr. Riaz Abdul Halim**



procurement, high risk associated with food products, frequent dispute among member farmers whereas, the lack of credit facility in the area was experienced by the member farmers.

## **An Economic Study of Plant Nurseries in the Lower Brahmaputra Valley Zone of Assam**

*Zeinab Riyaz*

Plant nurseries constitute the basis for sturdy growth and development of the seedlings during their initial stages of development. It is observed that nursery-grown plants have a healthy and long life. However, plant nurseries as a business activity are being taken by numerous individuals as their source of income. Most of the people have taken nursery business as their way of livelihood, which is also generating employment for the unemployed. The present study entitled “An Economic study of Plant nurseries in the Lower Brahmaputra Valley Zone of Assam” was undertaken to study the economics associated with the nursery business, with the objectives of examining cost and returns in the plant nurseries, analyzing the resource use efficiency, and identifying the constraints faced by the nursery growers in the development of plant nurseries. The nurseries were categorized based on their size viz., 1 ha (Group C). The highest operational cost was found in the case of Group C nurseries, followed by Group B nurseries and Group A nurseries. The major cost involved in operational cost was the cost of seed material and hired labor on a per hectare basis. In the case of fixed cost, the group which incurred the highest cost was Group A followed by Group B and Group C. It was due to the higher rental value of leased in land and higher rental value of own land on a per ha basis. The highest gross income per ha was found to be highest in Group C nurseries followed by Group B and Group A. The benefit-cost ratio of Group A nursery was 1.43, for Group B it was 1.51 and for Group C it was 1.64. In Group A the MVP value for seed material, manure/media, and polybags/pots were found to be  $>1$  which indicated that these resources were underutilized. While the MVP for chemical fertilizer/plant protection chemicals/hormones was found to be 1 which indicated that these inputs were underutilized ( $R^2=0.92$ ). In Group C, the MVP value for hired labor, seed material, and manure/media was found to be  $>1$  which indicated that these resources were underutilized, while the MVP for chemical fertilizer/plant protection chemicals/hormones, polybags/pots, and electricity was found to be 1 which indicated that these recourse were cover-utilized ( $R^2=0.80$ ). the constraint which ranked 1 was the lack of infrastructure facilities.

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**Abstract of M.Sc. thesis**

**Department: Agricultural Economics & FM (MBA)**

**Major Adviser: Dr. Ramen Das**

## **Effect of nutrient management and mulching on 'baby corn' (*Zea mays* L.)**

*Abhinanda Hazarika*

A field experiment entitled “Effect of nutrient management and mulching on ‘baby corn’ (*Zea mays* L.)” was carried out at the Instructional-Cum-Research (ICR) farm, Assam Agricultural University, Jorhat during summer season of 2022 with the view to evaluate the effect of nutrient management and mulching on growth and yield of ‘baby corn’. The experiment was laid out in factorial RBD with three replications. The treatments consisted of two factors, viz., two mulching practices [Conventional tillage with no mulching (M1) and conventional tillage with straw mulching @ 2.5 t/ha (M2)] and five nutrient management practices [Control (N1) without N-P2O5-K2O and organic manure; RDF (N2) 120-60-60 kg N-P2O5-K20/ha; FYM @ 5 t/ha (N3); 10 kg N/ha through FYM + 110 kg N/ha through fertilizer (N4); and 20 kg N/ha through FYM + 100 kg N/ha through fertilizer (N5)]. The soil of experimental site was sandy loam in texture, acidic in reaction (5.12), medium in organic carbon (0.52 %) and low in available N (201.93 kg/ha), medium in available P2O5 (27.48 kg/ha) and K2O (147.94 kg/ha). The experimental findings revealed that application of straw mulching @ 2.5 t/ha (M2) resulted in significantly higher values of growth parameters [like, plant height, number of leaves/plant, dry matter accumulation, leaf area index and crop growth rate], yield attributes [like, no. of cobs/plant, length, girth and weight of cob with and without husk] and cob yield with husk (84.62 q/ha), cob yield without husk (16.76 q/ha) and green stover yield (27.49 t/ha). Paddy straw mulching @ 2.5 t/ha also reported significantly lower values of weed density and weed dry matter production. The NPK content and uptake in cob and stover along with the total NPK uptake of the crop was highest with the application of paddy straw mulching @ 2.5 t/ha over that in no mulching treatment. The application of straw mulching @ 2.5 t/ha also recorded significantly higher values of soil available N, P2O5, K2O, soil moisture, soil microbial biomass carbon, fungal and bacterial population. Among the nutrient management practices, application of 20 kg N/ha through FYM + 100 kg N/ha through fertilizer (N5) resulted in significantly higher values of growth and yield attributing parameters like, plant height, number of leaves/plant, leaf area index, dry matter accumulation, crop growth rate and number of cobs/plant, length and girth of cob without husk and weight

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**Abstract of M.Sc. thesis**

**Department: Agronomy**

**Major Adviser: Dr. N. C. Deka**

of cob (with and without husk). Significantly higher cob yield with husk of 91.83 q/ha and cob yield without husk of 20.40 q/ha and green stover yield (29.83 t/ha) was recorded with application of 20 kg N/ha through FYM + 100 kg N/ha through fertilizer (N5) followed by application of RDF (120-60-60 kg N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O/ha) (N2). Significantly higher weed density and weed dry matter was recorded with the application of 20 kg N/ha through FYM + 100 kg N/ha through fertilizer (N5). The nutrient content and nutrient uptake in cob and stover, total NPK uptake were significantly higher with the application of 20 kg N/ha through FYM + 100 kg N/ha through fertilizer (N5). The soil available N, P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O, soil microbial biomass carbon, fungal and bacterial population were also found to be significantly higher with application of 20 kg N/ha through FYM + 100 kg N/ha through fertilizer (N5). The interaction effect of mulching and nutrient management was found to be significant in case of length of cob without husk, weight of cob without husk and yield of cob (with and without husk). In case of length and weight of cob without husk, highest values were recorded at treatment combination of M2N5 i.e., M2 (conventional tillage with straw mulching @ 2.5 t/ha) and application of 20 kg N/ha through FYM + 100 kg N/ha through fertilizer (N5). Similarly, the highest cob yield with and without husk were also recorded at treatment combination of M2N5. In terms of economics, the highest gross return (₹ 216450/ha), net return (₹ 176683/ha) and benefit-cost ratio (4.44) were observed at treatment combination of M2N5 i.e., M2 (conventional tillage with straw mulching @ 2.5 t/ha) and application of 20 kg N/ha through FYM + 100 kg N/ha through fertilizer (N5) followed by treatment combination of M2N2 i.e., M2 (conventional tillage with straw mulching @ 2.5 t/ha) and (N2) application of RDF (120-60-60 kg N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O/ha).

## **Weed management in late sown wet seeded kharif rice**

*Alam Hazarika*

A field experiment entitled “Weed management in late sown wet seeded kharif rice” was carried out in the year 2020 in the Instructional-Cum-Research (ICR) farm, Assam Agricultural University, Jorhat to study the effects of different weed management practices on weed parameters, growth and yield of late-sown wet seeded kharif rice. The experiment was laid out in a randomized block design (RBD) with three replications. The experiment consisted of twelve weed management treatments viz., weedy check (T1), weed free (T2), pretilachlor 30.7 EC with safener PE (pre-emergence) fb 1 manual weeding at 30 DAS (days after sowing) (T3), pretilachlor 30.7 EC with safener PE fb 1 mechanical weeding at 30 DAS (T4), pretilachlor 30.7 EC with safener PE fb bispyribac-sodium 10 SL @ 25 g a.i. ha-1 PoE (post-emergence) (T5), pretilachlor 30.7 EC with safener PE fb penoxsulam 2.5 OD @ 1000 ml ha-1 (T6), bispyribac-sodium 10 EC @ 25 g a.i. ha-1 PoE + pyrazosulfuron @ 20 g a.i. ha-1 PoE (20 DAS) (T7), bispyribac-sodium 10 EC @ 25 g a.i. ha-1 PoE + pyrazosulfuron @ 20 g a.i. ha-1 PoE + one spot hand weeding (T8), penoxsulam 2.5 OD @ 1000 ml ha-1 + almix @ 20 g ha-1 (T9), trifamone 20 WG + ethoxysulfuron 10 EC (Pre-mix) @ 225 g ha-1 + one spot hand weeding (T10), two mechanical weeding at 15 and 30 DAS (T11) and almix (Metsulfuron+ Chlorimuron) @ 20 g ha-1 + need based one spot hand weeding (T12). The experimental field was infested with different types of grasses viz., *Echinochloa crusgalli*, *Setaria pumila*, *Digitaria ciliaris*, *Leersia hexandra*, *Eleusine indica* (L.), and *Panicum repens* L sedges viz., *Cyperus difformis* L., *Cyperus iria* L., *Fimbristylis littoralis*, *Cyperus rotundus* L., *Scirpus juncooides* Roxb. and broad-leaved weeds viz., *Ludwigia decurrens*, *Alternanthera philoxeroides*, *Cuphea carthagenensis*, *Acmella ciliata*, *Marselia quadrifolia*, *Eclipta alba*, *Sphenoclea zeylanica*, *Hydrolea zeylanica*, *Portulaca oleracea*, *Sagittaria guayanensis* and *Monochoria vaginalis*. Among the different weed management practices, weed free treatment (T2) recorded the lowest weed density and weed dry weight, highest weed control efficiency and highest weed control index at all growth stages as well as recorded the highest growth characters, yield attributes, grain yield, straw yield and harvest index. Results revealed that apart from the weed free treatment, application of bispyribac-sodium 10 EC @ 25 g a.i. ha-1

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**Abstract of M.Sc. thesis**

**Department: Agronomy**

**Major Adviser: Dr. K. Pathak**

PoE + pyrazosulfuron @ 20 g a.i. ha<sup>-1</sup> PoE (20 DAS) (T7) at 60,90 DAS and at the time of harvest shown the lowest weed density, weed dry weight, highest weed control index, highest weed control efficiency as well as recorded the highest yield attributes, grain yield and straw yield. Significantly higher uptake of nitrogen, phosphorus and potassium in grain, straw and total uptake by late-sown wet seeded sali rice was recorded in the treatment consisting of bispyribac-sodium 10 EC @ 25 g a.i. ha<sup>-1</sup> PoE + pyrazosulfuron @ 20 g a.i. ha<sup>-1</sup> PoE (20 DAS) (T7), next to weed free treatment (T2). Beside weed free, the herbicide combination of bispyribac-sodium 10 EC @ 25 g a.i. ha<sup>-1</sup> PoE + pyrazosulfuron @ 20 g a.i. ha<sup>-1</sup> PoE (20 DAS) (T7) recorded the highest grain yield (2.54 t ha<sup>-1</sup> ) and it was statistically at par with two mechanical weeding at 15 and 30 DAS (T11) and bispyribac-sodium 10 EC @ 25 g a.i. ha<sup>-1</sup> PoE + pyrazosulfuron @ 20 g a.i. ha<sup>-1</sup> PoE + one spot hand weeding (T8). In case of economics, higher net return (₹. 43,704.90 ha<sup>-1</sup> ) and B:C ratio (1.75) was recorded with the application of bispyribac-sodium 10 EC @ 25 g a.i. ha<sup>-1</sup> PoE + pyrazosulfuron @ 20 g a.i. ha<sup>-1</sup> PoE (20 DAS) (T7).

# **Production Potentiality of Organic Foxtail Millet (*Setaria italica* L.) under Conservation Tillage in Rice Fallow Ecosystem**

*Archita Ojah*

A field experiment entitled “Production potentiality of organic foxtail millet (*Setaria italica* L.) under conservation tillage in rice fallow ecosystem” was conducted at Instructional-Cum-Research (ICR) farm, Assam Agricultural University, Jorhat from February to June, 2022, with a view to study the effect of different tillage practices and foxtail millet cultivars on growth, yield and quality along with its impact on soil health and system energetics. The experiment was laid out in a split plot design having three replications. The treatments consisted of three tillage practices viz., conventional tillage (T<sub>1</sub>), minimum tillage (T<sub>2</sub>), zero tillage (T<sub>3</sub>) in the main plot and four foxtail millet cultivars viz., Gossaigaon Yellow (C<sub>1</sub>), Gossaigaon Brown (C<sub>2</sub>), Majuli local (C<sub>3</sub>) and SiA-3156 (C<sub>4</sub>) in the subplot. The soil of the experimental site was sandy loam in texture, acidic in reaction (pH 5.4), medium in organic carbon (0.83%), low in available N (244.23 kg/ha) and available P<sub>2</sub>O<sub>5</sub> (22.45 kg/ha) while medium in available K<sub>2</sub>O (146.56 kg/ha). Experimental findings revealed that different tillage levels significantly influenced the growth parameters, yield attributing characters, grain and stover yield, nutrient uptake by different foxtail millet cultivars, soil health and system energetics. Conventional tillage gave significantly higher values in almost all the growth characters viz., plant height, number of leaves/plant, leaf area index, leaf area duration, dry matter production/plant and crop growth rate under study. Similarly, conventional tillage also gave significantly higher values in respect of yield attributing characters like number of effective tillers per plant, number of spikelets/panicle, number of filled grains/panicle, length and weight of the panicle and 1000-grain weight. Significantly higher grain yield (1198.56 kg/ha), harvest index (39%) and crude protein content (9.79%) in grains were observed in conventional tillage followed by minimum tillage. Additionally, conventional tillage showed highest N, P and K-uptake by grain and stover of foxtail millet. The available N, P and K contents in soil and better soil biological activities after harvest were highest in zero tillage. Energetics studies revealed that zero tillage had the highest energy use efficiency (58.33%). Significantly higher gross return and net return

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**Abstract of M.Sc. thesis**

**Department: Agronomy**

**Major Adviser: Dr. Jogesh Goswami**

were recorded under conventional tillage. The cultivar SiA-3156 gave significantly higher values in respect of all growth parameters studied viz., plant height, number of leaves/plant, leaf area index, leaf area duration, dry matter production/plant and crop growth rate. Among the cultivars, SiA3156 proved to be superior in terms of yield attributing characters like number of effective tillers/m<sup>2</sup>, number of spikelets/panicle, number of filled grains/panicle, length and weight of the panicle and 1000-grain weight along with highest uptake of N, P and K by grain and stover of foxtail millet. The available N, P and K content in soil after harvest of Majuli cultivar were found to be highest than under other cultivars. The foxtail millet cultivar SiA-3156 showed significantly higher energy use efficiency (56.06 %), higher net return and B: C. The highest interaction effect was recorded for the treatment combination T<sub>1</sub>C<sub>4</sub> where SiA-3156 was grown under conventional tillage in respect of dry matter accumulation at 90 DAS (10.57 g), number of effective tillers/m<sup>2</sup> (42.32), filled grains/panicle (1430), grain yield (1533.89 kg/ha) and uptake of N, P and K by grains and stover over rest of the treatment combinations. Energetics studies revealed that the energy use efficiency was found to be highest (72.84 %) when SiA-3156 cultivar was grown under zero tillage system. From economics point of view, the treatment combination T<sub>1</sub>C<sub>4</sub> i.e., SiA-3156 cultivar grown under conventional tillage recorded higher gross (₹94334) and net return (₹63924), respectively whereas the treatment combination of growing SiA-3156 under minimum tillage (T<sub>2</sub>C<sub>4</sub>) recorded the highest B: C (2.11).



## **Effect of Drip Irrigation on Growth and Yield of Onion (*Allium cepa* L.)**

*Deep Jyoti Barman*

A field experiment entitled “Effect of drip irrigation on growth and yield of onion (*Allium cepa* L.)” was conducted at the Instructional-Cum-Research (ICR) farm of Assam Agricultural University, Jorhat during the rabi season of 2021-2022. The objectives of the experiment were to find out optimum irrigation regime for proper growth and yield of onion under drip irrigation, estimation of yield response (Ky) to soil water for onion under different irrigation regimes and to analyze the nutrient dynamics in soil and plant. The onion variety ‘AgriFound Light Red’ was selected for the experimentation. The treatments were laid out in a randomized block design (RBD) with three replications. The experiment consisted of seven irrigation treatments viz. drip at 120% ETc (I<sub>1</sub>), drip at 100 % ETc (I<sub>2</sub>), drip at 80% ETc (I<sub>3</sub>), drip at 60% ETc (I<sub>4</sub>), drip at 40% ETc (I<sub>5</sub>), conventional (I<sub>6</sub>) and rainfed (I<sub>7</sub>). The soil of the experimental area was sandy loam in texture, acidic in nature (pH 5.9), medium in organic carbon (0.62%), low in available nitrogen (220.7 kg/ha), medium in available phosphorus (28.7 P<sub>2</sub>O<sub>5</sub> kg/ha) and low in available potassium (130.5 K<sub>2</sub>O kg/ha). Results revealed that among the various irrigation schedules, drip at 120% ETc (I<sub>1</sub>) resulted in higher plant count/m<sup>2</sup> and significantly higher plant height, number of leaves/plant in different growth stages of onion followed by drip at 100 % ETc (I<sub>2</sub>). Again, in terms of yield attributing characters drip at 120% ETc (I<sub>1</sub>) resulted in significantly higher values of mean polar diameter, equatorial diameter, geometric mean diameter and average bulb yield. However, bulb shape index (B.S.I.) was found to be non-significant to different irrigation schedules. Significantly higher bulb yield (195q/ha), stalk yield (22.22q/ha), fresh weight (72.43g) and dry weight (59.8g) of onion bulb was obtained under drip at 120% ETc (I<sub>1</sub>) treatment followed by drip at 100 % ETc (I<sub>2</sub>) treatment. Whereas, numerically higher value was obtained under I<sub>7</sub> (rainfed) for bulb stalk ratio, drying factor and harvest index. In case of water studies, drip at 120% ETc (I<sub>1</sub>) treatment showed significantly higher values for plant water content (PWC) and relative leaf water content (RLWC) in different growth stages of onion. Highest irrigation water was used in conventional (440.00 mm) and significantly higher irrigation water use efficiency

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(IWUE) was found at treatment I5 (drip at 40% ETc). Yield response factor (Ky) varied from 1.97 under rainfed (I7) to -1.26 in conventional irrigation (I6). The soil available N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O were found to be significantly higher in rainfed (I7) over other irrigation treatments in different growth stages of onion and at harvest. The nutrient content was found to be non-significant among different irrigation treatments in different growth stages of onion and at harvest, whereas in terms of nutrient uptake the treatments drip at 120% ETc (I<sub>1</sub>) and drip at 100 % ETc (I<sub>2</sub>) were found to be statistically at par at different growth stages of onion and at harvest. In terms of economics, treatment drip at 120% ETc (I<sub>1</sub>) also recorded the maximum gross return (5,85,000 Rs./ha), net return (4,46,500 Rs./ha) and B C ratio (3.22) followed by drip at 100 % ETc (I<sub>2</sub>) treatment. Thus, from the study it can be concluded that drip irrigation has significant influence on the growth, yield and income of onion. With better net return and benefit cost ratio up to 60% of ETc, drip at 120% ETc (I<sub>1</sub>) found to be the best option for maximum net return (Rs.4,46,500/ha) and BC ratio (3.22). The yield response values ranged from (-1.26) at conventional irrigation to (1.97) under rainfed situation. In nutrient dynamic, the relationship between irrigation treatment and nutrient content in plants was neutral; however, relationship with soil available nutrient was negative. The treatment without any irrigation (rainfed) recorded the highest available N, P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O of soil at different growth stages and lowest in drip irrigation at 120% ETc of soil. Being at par with drip at 100 % ETc (I<sub>2</sub>), N, P and K uptake by onion was higher in drip irrigation at 120 % ETc (I<sub>1</sub>)

## **Effect of Fertilizer Management on Growth and Yield of Local Small Potato Cultivars under Rainfed Condition of Assam**

*Deepsikha Gogoi*

A field experiment entitled “Effect of fertilizer management on growth and yield of local small potato cultivars under rainfed condition of Assam” was conducted during rabi, 2021-22 at the experimental area of the Department of Agronomy, BNCA. The objectives of the experiment were: (i) Find out the optimum fertilizer dose for local small tuber potato and (ii) Study of growth, yield and economics of local small tuber potato. There were 12 treatments consisting of two small tuber potato varieties viz., V1: Local white eyed small tuber potato and V2: Local red eyed small tuber potato and 6 Fertility Management treatments viz., F1: Control (No Fertilizers), F2: 25% RDF (Recommended Dose of Fertilizers), F3: 50% RDF, F4: 75% RDF, F5: 100% RDF and F6: 125% RDF (RDF= 60;50:50 kg N P<sub>2</sub>O<sub>5</sub> K<sub>2</sub>O/ha). The experiment was laid out in a Split Plot design with three replications placing varieties in the main plots and fertility managements in sub-plots. The soil of the experimental site was acidic (pH 4.73), sandy loam in texture, medium in organic carbon (0.61%), medium in available N (291.25 kg ha<sup>-1</sup>), low in available P<sub>2</sub>O<sub>5</sub> (14.40 kg ha<sup>-1</sup>) and K<sub>2</sub>O (117.60 kg ha<sup>-1</sup>) respectively. Results revealed that there was no significant effect of varieties on morphological parameters like plant height, branches per plant and green leaves per plant, phenological and physiological parameters. However, the effect of fertility management was found to be significant in respect of morphological and physiological parameters except phenological parameters. Between the varieties, V2 (local red eyed small tuber potato) showed better performance in terms of yield attributing characters (tubers per plant, tuber weight per plant and Production Efficiency) and yield over V1 (local white eyed small tuber potato). Among the fertility treatments, F6 (125% RDF) recorded the highest tuber yield (21.36 t ha<sup>-1</sup>) which was statistically at par with F5 (100% RDF) i.e. 19.14 t ha<sup>-1</sup>. In terms of economics, V2 (local red eyed small tuber potato) recorded the highest net return (Rs. 143636/- ha<sup>-1</sup>) with B:C ratio of 1.98 than V1 (local white eyed small tuber potato). Among the fertility management, 125% RDF recorded the highest net return of Rs. 296640/- ha<sup>-1</sup> which is statistically at par with 100% RDF which is Rs.

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253126/- ha<sup>-1</sup> . The effect of varieties on post- harvest soil properties (soil moisture, soil pH, soil organic carbon % and available N, P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O kg ha<sup>-1</sup> ) were found to be non-significant. However, the effect of fertility management on these characters (N, P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O kg ha<sup>-1</sup> ) produced significant differences recording highest value at F6 (125% RDF) over other treatments. Between the varieties, V2 showed higher crop uptake of NPK (kg ha<sup>-1</sup> ) at harvest. Fertility management exerted significant influence on total uptake of NPK (kg ha<sup>-1</sup> ). From the experiment, it can be concluded that local red eyed small tuber potato (V2) recorded higher yield and economic return over local white eyed small tuber potato (V1). The fertility treatment of 125% RDF was superior and statistically at par with 100% RDF which can be used as a fertilizer dose for small tuber potato.

# **Effect of Sowing Dates and Seed Priming on Growth and Yield of Rapeseed under Rainfed Condition**

*Hidangmayum Shreera*

A field experiment entitled “Effect of sowing dates and seed priming on growth and yield of rapeseed under rainfed condition” was conducted during rabi, 2020-21 at the PG Experimental Field of the Department of Agronomy, BNCA. The objectives of the experiment were (i) To find out the effect of sowing dates and seed priming on growth parameters of rapeseed and (ii) To study the effect of different treatments on yield and yield attributes of rapeseed. The treatments consisted of 3 levels of dates of sowing viz., 30th October (D1), 15th November (D2) and 1st December (D3) and 5 levels of seed priming methods viz., Farmer’s practice (S0), Water soaked for 10hrs (S1), Potassium chloride (KCl) @ 2% for 10hrs (S2), Sodium chloride (NaCl) @ 1% for 8hrs (S3) and Potassium dihydrogen phosphate (KH<sub>2</sub>PO<sub>4</sub>) @ 1% for 10hrs (S4) with three replications. The soil of the experimental site was acidic (pH 4.64), sandy loam in texture, medium in organic carbon content (0.64%), low in available N (232.06 kg ha<sup>-1</sup>), P<sub>2</sub>O<sub>5</sub> (21.65kg ha<sup>-1</sup>) and K<sub>2</sub>O (113.20 kg ha<sup>-1</sup>) having a bulk density of 1.42 (g cm<sup>-3</sup>). The results revealed that sowing of the crop at different dates and different seed priming techniques had significant effect on most of the growth and yield attributes viz., emergence percentage, plant height, stem dry weight, leaf dry weight, reproductive dry weight, total dry weight, leaf per plant, leaf area per plant, LAI, CGR, RGR, number of primary branches per plant, total chlorophyll content, plant population, siliqua per plant, seeds per siliqua, seed yield per plant, seed yield, stover yield and HI. There was significant increase in the plant height, dry matter accumulation, no. of leaves, leaf area, LAI, CGR, RGR from 30DAS to harvest. However, dates of sowing did not show any significant effect on RGR at 60DAS. Moreover, both dates of sowing and seed priming did not show any significant effect on test weight. Among the different dates of sowing the crops sown on 15th November recorded the highest seed yield and harvest index (8.93 q ha<sup>-1</sup> and 44.03 %respectively) which was statistically superior over the crop sown on 1st December. Similarly, among the seed priming methods the crops primed with KCl 2% for 10hrs showed highest seed yield (9.96 q ha<sup>-1</sup>) and harvest index (44.49

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%). The highest gross return (Rs 40,188 /ha), net return (Rs 20,210 /ha) and B:C ratio (2.01) was recorded from the crop sown on 15th November (D2). Different seed priming methods recorded significantly higher values for KCl @ 2% for 10 hrs priming (S2) with highest gross return (Rs 44,830 /ha), net return (Rs 24,835/ha) and B:C ratio (2.24). Interaction between sowing dates and seed priming showed significant differences in the economic parameters. 15th November sowing with KCl @ 2% for 10 hrs priming (D2S2) resulted in highest gross return (Rs 53,310 /ha), net return (Rs 33,315/ha) and B:C ratio (2.67). From the findings of the present experiment, it can be concluded that sowing of rapeseed on 15th November and seed priming with KCl @ 2% for 10 hrs can be suggested for higher productivity of the crop and better profitability to the farmers.

## **Intercropping of Linseed (*Linum usitatissimum*) and Lathyrus (*Lathyrus sativus*) as Influenced by Moisture Conservation Practice in Rice Fallow**

*Himadri Saikia*

A field experiment entitled “Intercropping of linseed (*Linum usitatissimum*) and lathyrus (*Lathyrus sativus*) as influenced by moisture conservation practice in rice fallow” was conducted at the Instructional Cum Research (ICR) Farm of Assam Agricultural University, Jorhat during the *Rabi* season of 2021-2022. The objectives of the experiment were to evaluate a suitable linseed and lathyrus intercropping system (s) in rice fallow and to evaluate the effect of mulching (moisture conservation practice) on the growth and yield of linseed and lathyrus intercropping system. The variety of linseed and lathyrus grown were “T-397” and “Prateek”, respectively. The treatments were laid out in a factorial randomized block design (FRBD) with three replications. The experiment consisted of two factors, viz., mulching and cropping systems. Treatments consisted of two mulching treatments viz., no mulching (M<sub>0</sub>) and mulching @ 2 tonnes/ha (M<sub>1</sub>) and five cropping systems viz., sole linseed (C<sub>1</sub>), sole lathyrus (C<sub>2</sub>), linseed:lathyrus 1:1 ratio (C<sub>3</sub>), linseed:lathyrus 2:1 ratio (C<sub>4</sub>) and linseed:lathyrus 3:1 ratio (C<sub>5</sub>). Both linseed and lathyrus were sown on the 6th of December, 2021. Lathyrus was harvested on 31st march, 2022 (115 days after sowing) while linseed was harvested on 5th of April, 2022 (120 days after sowing). The soil of the experimental site was sandy loam in texture and acidic in reaction (pH 5.43), medium in organic carbon (0.63%), low in available nitrogen (197.12 kg/ha), medium in available phosphorus (25.86 P<sub>2</sub>O<sub>5</sub> kg/ha) and medium in available potassium (180.57 K<sub>2</sub>O kg/ha). Results from the experiment revealed that mulching @ 2 tonnes per hectare significantly enhanced the plant height, number of branches/plants, dry matter/plant, number of leaves/plants, yield attributing characters and seed and stover yield of both linseed and lathyrus. Mulching also resulted in higher soil moisture content along with reduced weed density and biomass. The nutrient content and nutrient uptake of both linseed and lathyrus were significantly higher in mulching over no mulch. The soil available N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O were also higher in mulching as compared to non-mulch. The growth, as well as yield parameters and yield of both linseed and lathyrus, were significantly

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affected by different cropping systems. In case of linseed, the growth parameters and yield attributing characters were the highest in linseed:lathyrus 1:1 ratio. This was followed by 2:1 and 3:1 ratio while sole linseed recorded the lowest growth and yield attributes. However, the highest seed and stover yield were obtained from sole linseed due to its higher plant population. The nutrient content (N, P, K) in both seeds and stover of linseed was also highest in linseed:lathyrus 1:1 ratio. This trend was reverse in case of lathyrus as the growth and yield attributes of lathyrus were better in sole lathyrus as compared to intercropping systems. But, among the intercropping systems, linseed + lathyrus in 1:1 ratio recorded better growth characters, yield attributes and yield of lathyrus as compared to the other intercropping systems. The 1:1 linseed:lathyrus ratio also recorded the highest nutrient content and uptake among the intercropping systems. In terms of calculation of biological efficiencies, linseed:lathyrus 1:1 ratio recorded the highest relative crowding coefficient (3.88) and land equivalent ratio (1.44). The highest linseed equivalent yield (LEY) was recorded in linseed:lathyrus 1:1 ratio which also resulted in the highest gross return, net return and B:C ratio compared to all other cropping systems. Although mulching had incurred additional cost of cultivation, yet it had resulted in higher gross return, net return and B:C ratio over nonmulching due to increased productivity. Considering the overall economics of the system, linseed:lathyrus 1:1 ratio combined with mulching @ 2 tonnes per hectare resulted in highest mean gross return (42377.15 Rs/ha), net return (22392.15 Rs/ha) and benefit-cost ratio (2.12). This was followed by linseed:lathyrus 2:1 and 3:1 ratio in combination with mulching. Sole crops without mulching recorded the lowest income and benefit-cost ratio.



# **Effect of Seed Priming and Moisture Conservation Measures on Productivity and Profitability of Baby Corn (*Zea mays* L.) under Rainfed Upland Situation**

*Himashree Goswami*

A field experiment was conducted during rabi, 2020-21 at the PG experimental plot of the department of agronomy, BNCA to assess seed priming and moisture conservation measures on babycorn under rainfed situation for productivity and profitability. The soil of the experimental site was acidic (pH 4.64), sandy loam in texture, medium in organic carbon (0.64%), low in available N (232.06 kg ha<sup>-1</sup>), P<sub>2</sub>O<sub>5</sub> (13.84 kg ha<sup>-1</sup>) and K<sub>2</sub>O (115.27 kg ha<sup>-1</sup>). The treatments consist of 4 levels of seed priming technologies viz. S0: No priming; S1: Seed priming with 1% urea solution; S2: priming with 1% potash solution (MOP); S3: priming with 3 times diluted cow urine and 3 levels of soil moisture conservation measures viz. M0: No mulching; M1: use of bio mulch; M2: use of black polythene mulch replicated three times in factorial randomized block design. Results revealed that the performance of different seed priming methods in seedling emergence of babycorn crop was significant upto 6 days after sowing but different moisture conservation measures could not bring any significant effect in the field emergence of babycorn seedlings. The highest and quick seedling emergence (11.96 numbers m<sup>2</sup>) was recorded under the treatment of seed priming with three times diluted cow urine which was at par with the treatment of seed priming with 1% urea solution and 1% KCl (MOP) solution. Different growth, yield attributing characters and yield of babycorn were also significantly affected due to moisture conservation measures but seed priming methods could not bring any significant effect on growth and yield parameters. The total number of leaves m<sup>-2</sup>, total leaf area plant<sup>-1</sup> and leaf area index (LAI) of babycorn were also changed significantly due to different moisture conservation measures but those parameters remain static due to different seed priming methods. The CGR (g m<sup>-2</sup> day<sup>-1</sup>), RGR, (g g<sup>-1</sup> day<sup>-1</sup>) and NAR (mg cm<sup>-1</sup> day<sup>-1</sup>) of babycorn were also changed significantly due to different soil moisture conservation measures. The highest and significant babycorn yield without husk (22.59 q ha<sup>-1</sup>) with 305.61 q ha<sup>-1</sup> of green fodder yield were recorded under the

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treatment where black polythene mulching was used as soil moisture conservation measure. The significantly highest harvest index (6.00), production efficiency (25.67 kg<sup>-1</sup> Day<sup>-1</sup> ha<sup>-1</sup>) and nutrient use productivity (9.41 kg<sup>-1</sup> ha<sup>-1</sup> kg<sup>-1</sup>) were recorded under the treatment of moisture conservation by using black polythene mulching. Different seed priming methods and soil moisture conservation measures could not bring any significant effect on the post crop soil reaction and organic carbon content in soil but the NPK status of soil after harvest of babycorn were significantly affected by different soil moisture conservation measures. The highest gross return (Rs. 372782 ha<sup>-1</sup>), net return (Rs. 213372 ha<sup>-1</sup>), B:C (2.34) ratio and economic efficiency (Rs. 2425ha<sup>-1</sup> Day<sup>-1</sup>) were recorded superior where seeds were primed with 1% potash (MOP) solution and black polythene mulch recorded a gross return(Rs. 399972 ha<sup>-1</sup>), net return (Rs. 231132 ha<sup>-1</sup>), B:C (2.37) ratio and economic efficiency (Rs. 2627ha<sup>-1</sup> Day<sup>-1</sup>). From the present investigation, it can be concluded that the babycorn crop can be grown for higher productivity and profitably by following seed priming with 1% urea, 1% potash (MOP) solution or 3 times diluted cow urine for eight hours alongwith black polythene mulching as soil moisture conservation measure.

## **Studies on the effect of paired row planting and weed management in baby corn (*Zea mays* L.)**

*Imonjyoti Das*

A field experiment entitled “Studies on the effect of paired row planting and weed management in baby corn (*Zea mays* L.)” was conducted at the Instructional cum-Research (ICR) Farm, Assam Agricultural University, Jorhat during summer season of 2021 with a view to find out the effect of paired row planting and weed management on growth and yield of baby corn. The experiment was laid out in a factorial RBD design with three replications. The treatments consisted of two paired row planting methods viz., P1: Paired row (60/30 cm), P2: Paired row (70/20 cm) as levels of first factor, six weed management practices viz., M1: Weedy check, M2: Weed free, M3: Tembotrione (Laudis) 100g/ha + steves mero 733g/ha + atrazine 300g/ha at 17 DAS, M4: Live mulching with cowpea for 3 weeks followed by uprooting and incorporation in the soil, M5: Intercropping with greengram + stubble mulch @ 1 t/ha and M6: Intercropping with greengram as levels of second factor and a Control (sole crop with recommended practices). The soil of the experimental site was sandy loam in texture, acidic in reaction (pH 5.07), medium in organic carbon (0.49%), available N (269.21 kg/ha), available P<sub>2</sub>O<sub>5</sub> (28.36 kg/ha), available K<sub>2</sub>O (158.72 kg/ha) and the bulk density 1.38 g/cc. During the crop season, total rainfall received was 594.5 mm. Results revealed that paired row planting in 70/20 cm resulted in higher growth parameters except plant height and number of green leaves per plant, as well as yield attributing characters like, number of cobs per plant, weight and length of cob with and without husk, and cob girth. The effect of these attributes reflected in higher cob yield with and without husk, and green fodder yield. Results also revealed that paired row planting in (70/20 cm) had significantly lower weed density and weed dry matter consequently resulting in better WCE and WCI in combination at 30 DAS and 60 DAS. In regards to above mentioned parameters there was no significant difference between paired row method of planting and control (sole baby corn with recommended practices). Experimental findings on weed management practices revealed that intercropping with greengram had significantly higher growth parameters except plant height of baby corn as compared to other weed management practices at 30 DAS, 60 DAS and at harvest. Intercropping with greengram had significantly higher number of cobs per plant, weight of cob and

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length of cob with husk as well as without husk and baby corn girth. Yield of cob with husk as well as without husk and fodder yield was found to be higher under intercropping with greengram. Experimental findings revealed that weed management practice of intercropping with greengram had significantly lower weed density as compared to other practices at 30 DAS and 60 DAS and as a result higher WCE and WCI in combination. The treatment means were statistically at par with control (sole baby corn with recommended practices) for the above-mentioned parameters. In terms of assessment of cropping system, paired row planting in 70/20 cm along with intercropping with greengram (P2M6) and paired row planting in 70/20 cm along with intercropping with greengram + stubble mulch @ 1 t/ha (P2M5) had the highest cob equivalent yield. Economics wise, among all the treatments, the P2M6 combination resulted higher gross (Rs.2,29,216.33), net return (1,80,566.33) and B:C ratio (3.71) which was closely followed by P1M6.

## **Performance of wet seeded rice with varying dates of sowing and levels of nitrogen in post-flood situation**

*Kandapu Sai Teja*

A field experiment was conducted at the Instructional-Cum-Research (ICR) Farm, Assam Agricultural University, Jorhat during kharif season in the year 2020 on the topic “Performance of wet seeded rice with varying dates of sowing and levels of nitrogen in post-flood situation” in order to investigate the effect of different sowing dates and nitrogen levels on growth and yield of wet seeded rice. The experiment was laid out in a split plot design with three replications. The treatment consisted of four dates of sowing viz. 10 th August (D1), 20 th August (D2), 30th August (D3) and 9 th September (D4) as main plot treatments and five levels of nitrogen viz. 40 kg (N1), 60 kg (N2), 80 kg (N3), 100 kg (N4) and 120 kg/ha (N5) were allotted in sub plots. The soil of the experimental site was sandy loam in texture, with acidic pH (5.50), medium in available N (282.75 kg/ha), low in available P<sub>2</sub>O<sub>5</sub> (20.21 kg/ha) and K<sub>2</sub>O (119.42 kg/ha). Total rainfall received during the cropping season was 739.8 mm distributed in 44 rainy days. The mean maximum and minimum temperatures during the crop period ranged from 23.9°C to 34.2°C and 8.2°C to 25.8°C, respectively. The results revealed that both grain and straw yields were significantly influenced by date of sowing and level of nitrogen. Among different sowing dates, sowing on 10th August (D1) produced highest grain yield (2759.85 kg/ha) and 9 th September (D5) sown crop produced highest straw yield (3792.50 kg/ha). Delay in the sowing date from 10 th August to 9 th September caused 80.74 per cent reduction in grain yield. All the growth and yield attributing characters recorded higher values on 10 th August (D1) sowing and decreased with delay in sowing date. Crop under earlier date of sowing accumulated a greater number of growing degree days. On the other hand, the residual available N, P and K in soil were significantly higher on 9 th September (D4) sowing as compared to earlier sowing dates. Higher grain yield (2224.58 kg/ha) and straw yield (3615.37 kg/ha) were recorded in nitrogen level 100 kg (N4) and 120 kg (N5), respectively. Most of the growth and yield parameters were found to be superior at higher levels of nitrogen. The highest net monetary return of ₹ 48,855.92 and benefit-cost ratio of 1.67 were recorded with treatment of 10th August sowing date combined with 100 kg N/ha (D1N4).

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## **Agronomic Bio Fortification of Potato With Zinc**

*Monika G*

A field experiment entitled “Agronomic biofortification of potato with zinc” was conducted at the Assam Agricultural University farm, Jorhat during the rabi season of 2021-22 with an objective to evaluate the zinc fertilization schedule to improve the growth, tuber yield and zinc content in potato tuber and to work out the economic advantage of nano zinc fertilizer application over conventional zinc fertilizer. The potato variety ‘*Kufri khyati*’ was planted on 18.11.2021 and harvested on 10.02.2022 and was laid out in a randomized block design (RBD) with three replications. The experiment consisted of eight treatments viz. control (T1), zinc @ 2.5 kg/ha at the time of planting (T2), zinc @ 5 kg/ha at the time of planting (T3), foliar application of zinc @ 2g/liter at 25 days after planting (T4), foliar application of zinc @ 2g/liter at 25 and 50 days after planting (T5), T2+foliar application of zinc @ 2g/liter at 25 days after planting (T6), T2+foliar application of zinc @ 2g/liter at 25 and 50 days after planting (T7) and foliar application of nano zinc @ 2g/liter at stolon formation stage (25 DAP) (T8). The soil of the experimental site was sandy loam in texture, acidic in reaction (pH 5.8), organic carbon (0.76%), available N (271.48 kg/ha), P<sub>2</sub>O<sub>5</sub> (21.33 kg/ha) and K<sub>2</sub>O (153.43 kg/ha). Results revealed that, foliar application of nano zinc @ 2 g/liter applied at stolon formation stage (25 DAP) (T8) significantly increased the plant height, number of leaves per plant, number of shoots per plant, leaf area index and high dry weight of haulm followed by foliar application of zinc @ 2g/liter at 25 and 50 DAP (T5). The treatment (T8) recorded higher number of stolon and tubers per plant, stolon weight per plant as well as grade-wise tuber number and yield. Significantly higher tuber yield of 32.21 t/ha was recorded under T8 followed by T5. Whereas, the lowest tuber yield was obtained with T3. Foliar application of nano zinc @ 2 g/liter at stolon formation stage (25 DAP) (T8) significantly enhanced the zinc content (35.1mg/kg) and dry matter content (21.4 %) as compared to control. The nutrient uptake by both haulm and tuber were significantly higher in all foliar zinc application over control. So far as the economics is concerned, foliar application of nano zinc @ 2 g/liter at stolon formation stage (25 DAP) (T8) recorded the maximum gross return (4,75,718 Rs/ha), net return (3,31,323 Rs/ha) and B:C ratio (3.27) followed by foliar application of zinc @ 2g/liter at 25 and 50 days after planting (T5).

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## **Effect of tillage and weed control methods on growth and yield of kharif sesamum (*Sesamum indicum* L.) under upland situation**

*Mrinmoy Jyoti Nath*

A field experiment entitled “Effect of tillage and weed control methods on growth and yield of kharif sesamum (*Sesamum indicum* L.) under upland situation” was carried out during kharif, 2020 at P.G. Experimental Field, Department of Agronomy, B.N. College of Agriculture, AAU, Biswanath Chariali with the objectives of (i) Assess the effect of tillage and weed control methods on weed population and growth in kharif sesamum (ii) Evaluate the effect of different treatments on growth and yield of kharif sesamum and (iii) Suggest an effective weed control method(s) for kharif sesamum. The experiment was laid out in a split-plot design with two tillage operations (Zero tillage and Conventional tillage) as main plot treatment and six weed control methods viz., manual weeding twice at 20 DAS and 40 DAS; Quizalofop-p-ethyl 5% EC @ 0.05 kg a.i. ha-1 at 20 DAS; Imazethapyr 10% SL @ 0.075 kg a.i. ha-1 at 20 DAS; Quizalofop-p-ethyl 5% EC @ 0.05 kg a.i. ha-1 at 20 DAS + Rotary weeding at 40 DAS; Imazethapyr 10% SL @ 0.075 kg a.i. ha-1 at 20 DAS + Rotary weeding at 40 DAS and unweeded (control) as sub-plot treatment, replicated thrice. The results of the present investigation revealed that, the conventional tillage significantly suppressed weed dry weight at 20 and 40 DAS and resulted in marked increase of weed control efficiency at 40 DAS. Conventional tillage also recorded comparatively lower weed density (at all crop growth stages); lower weed dry weight (60 DAS and at harvest) and higher weed control efficiency (60 DAS and at harvest) over zero tillage. Significantly higher plant dry weight, initial crop growth rate, and capsules plant-1 were recorded under conventional tillage and resulted in significant increased of seed yield (823.58 kg ha-1), stover yield (3118.29 kg ha-1), harvest index (26.58%) and gross return (Rs 52,408 ha-1). However, comparatively higher B:C was recorded in zero tillage over conventional tillage. Weed control methods had significant effect on reducing the weed density and weed dry weight at all the crop growth stages except at 20 DAS and resulted in increased weed control efficiency. Among the weed control methods, manual weeding twice recorded significantly lowest weed density, weed dry weight and better weed

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control efficiency over unweeded (control). Weed control methods also had significant effect on crop growth and yield attributing characters of sesamum. Among the weed control methods, manual weeding twice recorded significantly higher seed yield (1263.61 kg ha<sup>-1</sup> ), stover yield (3647.86 kg ha<sup>-1</sup> ), harvest index (30.40%) and B:C (2.67) and unweeded (control) recorded lowest seed yield (454.72 kg ha<sup>-1</sup> ), stover yield (2717.61 kg ha<sup>-1</sup> ) and B:C (1.39) in kharif sesamum. Cultivation of kharif sesamum under conventional tillage and weed suppression by manual weeding twice at 20 and 40 DAS can be judged as the best methods studied on the basis of better weed suppression, crop yield and economic indices.



## **Relative performance of niger varieties to graded levels of fertilizer under rainfed condition**

**Nikita Kaman**

During the rabi season of 2019-20, a field experiment entitled “Relative performance of niger varieties to graded levels of fertilizer under rainfed condition” was conducted at Instructional-cum-Research (ICR) Farm, Assam Agricultural University, Jorhat with a view to study the effect of varieties and graded levels of NPK on growth, yield and quality of niger and also the nutrient uptake by the crop and its availability in soil. The experiment was laid out in a factorial randomized block design (RBD), with three replications. The treatments consisted of four varieties viz., V1: NG-1, V2: GA-10, V3: JNS9 and V4: NB-1 and four levels of NPK viz., F1: 10-5-5 kg N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O/ha, F2: 20-10-10 kg N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O/ha, F3: 30-15-15 kg N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O/ha and F4: 40-20-20 kg N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O/ha. The soil of the experimental site was sandy loam in texture, acidic in reaction (pH 5.43), medium in organic carbon (0.56%), available N (283.14 kg/ha) and available K<sub>2</sub>O (156.55 kg/ha) while low in available P<sub>2</sub>O<sub>5</sub> (18.67 kg/ha). Experimental findings revealed that different varieties significantly influenced the growth parameters, yield attributing characters, seed and stover yield, oil content, oil yield and uptake of N, P and K by niger. The variety NB-1 gave significantly higher values in almost all the growth characters (viz., plant height, number of leaves per plant, leaf area index, number of branches per plant and dry matter production per plant) under study except chlorophyll content of leaves, which was higher in the variety GA-10. On the other hand, the variety GA-10 gave significantly higher values in respect of yield attributing characters like number of capitula per plant, number of seeds per capitulum and 1000-seed weight which were at par with JNS-9. Significantly higher seed yield was obtained in GA10 (491.87 kg/ha) which was at par with JNS-9 (470.24 kg/ha), whereas, the stover yield was the highest in NB-1 (2866.84 kg/ha). Harvest index was significantly higher in GA-10 (16.44%) and was at par with JNS-9 (15.90%) and NG-1 (15.50%). The variety GA-10 also produced significantly higher oil content (38.76%), oil yield (191.96 kg/ha), protein content (16.65%) and N, P and K content and uptake. The iodine value and saponification value of oil and available N, P and K content in soil after harvest of the crop was non-significant. Application of 40-20-20 kg N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O/ha, 30-15-15 kg N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O/ha and 20-10-10 kg N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O/ha gave

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statistically at par values in respect of all growth parameters studied viz., plant height, number of leaves per plant, leaf area index, number of branches per plant, dry matter production per plant and chlorophyll content of leaves. Among the levels of NPK, 40-20-20 kg N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O /ha proved superior in terms yield attributing characters like capitula per plant, number of seeds per capitulum, and seed (534.15 kg/ha) and stover yield (2981.05 kg/ha), oil yield (204.12 kg/ha) and uptake of N, P, and K by niger while number of seeds/capitulum was statistically at par with 30-15-15 kg N-P<sub>2</sub>O<sub>5</sub>- K<sub>2</sub>O/ha. However, the oil content was the highest at 30-15-15 kg N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O/ha (39.36%). No treatment differences were observed in respect of 1000-seed weight, harvest index, iodine value and saponification value of oil and available N, P and K content in soil after harvest of the crop due to levels of NPK. The highest interaction effect was recorded under the treatment combination- V2F4 (40-20-20 kg N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O /ha was applied to GA-10) in respect of number of capitula per plant (35.64), seed yield (623.90 kg/ha) and uptake of N and K by seed over rest of the treatment combinations. However, in regards to oil content the highest interaction effect was recorded when 30-15-15 kg N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O /ha (F3) was applied to variety GA-10 (V2). From the economic analysis, it has been found that the highest gross return (₹ 37,434.00), net return (₹ 22,413.00) and B-C ratio (2.49) were recorded in treatment combination of V2F4 i.e. when highest fertility level of NPK i.e. 40-20-20 kg N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O /ha was applied to the variety GA-10.

## **Evaluation of panchagavya as organic input for late sown rapeseed production**

*Nilakhi Das*

A field experiment entitled “Evaluation of panchagavya as organic input for late sown rapeseed production” was conducted at the organic block of the Instructional-cum-Research (ICR) Farm, Assam Agricultural University, Jorhat during rabi season of the year 2020- 2021 to evaluate the effects of panchagavya on growth, yield and economics of late sown rapeseed as well as their overall impact on soil health. The experiment was laid out in Randomised Block Design with three replications. The experiment consisted of eight treatments viz., T1: control (no organic input), T2: RDN through vermicompost, T3: Vedic panchagavya soil application (3%), T4: 1 tonne VC/ha as basal + Vedic panchagavya foliar application (3%), T5: enriched panchagavya soil application (3%), T6: enriched panchagavya foliar application (3%), T7: Vedic panchagavya basal application (1.5%) + Vedic panchagavya foliar application (1.5%), T8: enriched panchagavya basal application (1.5%)+ enriched panchagavya foliar application (1.5%). The soil of the site where experiment was carried out was sandy loam in texture, acidic in reaction. The soil of experimental site was medium in organic carbon (0.48 %), medium in available N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O (268.86, 21.87 and 172.82 kg/ha, respectively). The crop was sown on 9 December, 2020 and harvested on 19 March, 2021. The crop took average duration of 101 days during experimentation. Experimental findings revealed that different treatments significantly influenced both growth and yield attributing characters of late sown rapeseed. Maximum values of growth parameters were recorded in 1tonne VC/ha as basal + Vedic panchagavya FA (3%) treatment (T4). Maximum values of yield parameters were also observed under 1tonne VC/ha as basal + Vedic panchagavya FA (3%) treatment. The highest seed yield (6.89q/ha) and stover yield (20.48 q/ha) were recorded in this treatment (T4). The highest oil yield (258.91 kg/ha) of rapeseed and also increased nutrient content and uptake were recorded with application of 1tonne VC/ha as basal + Vedic panchagavya FA (3%). The better chemical properties of the soil after harvesting was recorded in RDN through VC (T2) treatment but better biological properties viz., microbial population i.e., bacteria (26.12 x 10<sup>7</sup> cfu/g of soil) and fungi (29.89 x 10<sup>4</sup> cfu/g of soil) and dehydrogenase activity (9.48 µg TPF/g/24 hrs) were recorded under treatment T4. The economic study revealed

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that the highest gross return (Rs. 55120/ha) was observed in 1 tonne VC/ha as basal + Vedic panchagavya foliar application (3%) (T4) treatment. But the maximum net return (Rs. 34020/ha) and B:C ratio (1.90) were recorded in enriched panchagavya foliar application (3%) (T6). From this study, it can be concluded that the Vedic panchagavya @ 3% as foliar application along with 1 tonne of VC/ha as basal (T4) under late sown condition was found to be the best among all the treatments in terms of growth and yield attributes as well as yield of the rapeseed var. TS-67. But, foliar application of enriched panchagavya @ 3% (T6) was identified as profitable among all the treatments with the highest B:C ratio of 1.90.

## **Performance of Rajmah Based Intercropping System Under Rainfed Situation**

*Nipika Rongpharpi*

A field experiment was conducted in the experimental field, All India Coordinated Research project on Dryland Agriculture, Biswanath Chariali centre, Biswanath college of Agriculture, Assam Agricultural University during the rabi season of 2020-21 to study the “Performance of Rajmah based intercropping system under rainfed situation”. The soil of the experimental site was sandy loam in texture, acidic in reaction (pH 4.98), medium in organic carbon (5.80 g kg<sup>-1</sup>), available N (330.10 kg ha<sup>-1</sup>), available K<sub>2</sub>O (171.35kg ha<sup>-1</sup>) and available P<sub>2</sub>O<sub>5</sub> (23.26 kg ha<sup>-1</sup>). The experiment was laid out in Randomized Block Design (RBD) involving three (3) replications with thirteen (13) treatments consisting of five (5) crops (rajmah, toria, linseed, lentil and buckwheat) which were grown solely as well as intercropped in different ratios of 1:1 and 2:1 viz. T1: sole rajmah, T2: sole toria, T3: sole linseed, T4: sole lentil, T5: sole buckwheat, T6: rajmah + toria (1:1), T7: rajmah + linseed (1:1), T8: rajmah + lentil (1:1), T9: rajmah + buckwheat (1:1), T10: rajmah + toria (2:1), T11: rajmah + linseed (2:1), T12: rajmah + lentil (2:1) and T13: rajmah + buckwheat (2:1). The competitive behavior of component crops in different intercropping system was determined in terms of land equivalent ratio (LER), relative crowding coefficient (RCC), aggressivity (A) and monetary advantage index (MAI). The results revealed that rajmah+lentil (2:1) intercropping system (T12) was found to be more economical and highest monetary advantage index (6012.08). The same system had the highest aggressivity value (+1.19 & -1.19 respectively) followed by rajmah + linseed (2:1). The relative crowding coefficient was >1 in rajmah among the intercropping treatments indicating yield advantage compared with sole cropping except T6, T9, T10 and T13 treatments. Rajmah intercropped with lentil under 2:1 ratio recorded the highest land equivalent ratio (1.18) and rajmah equivalent yield (13.46 qha<sup>-1</sup>). Economic analysis of the intercropping system revealed the highest gross return (Rs. 96,912.00 ha<sup>-1</sup>), net return (Rs. 66,132.00 ha<sup>-1</sup>) and benefit:cost ratio (3.1) under rajmah + lentil (2:1) ratio.

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## Effect of Plant Growth Promoting Microbes on Organically Grown Traditional Potato Cultivars

*Pankhi Priya Neog*

A field experiment entitled “Effect of plant growth promoting microbes on organically grown traditional potato cultivars” was conducted at the Instructionalcum-Research (ICR) Farm of Assam Agricultural University, Jorhat during the *rabi* season of 2021-2022. The objectives of the experiment were to find out the effect of plant growth promoting microbes on growth, physiological characters, yield and quality of traditional potato and to study the effect of plant growth promoting microbes on nutrient uptake and soil properties at harvest. The treatments were laid out in a factorial randomized block design (FRBD) with three replications. The experiment consisted of two factors viz., traditional potato cultivar and FYM enriched plant growth promoting microbes. The cultivars grown were “Axomiya” (C<sub>1</sub>) and “Rongporia”(C<sub>2</sub>). There were five treatments under the second factor viz., control (T<sub>1</sub>) (no application of FYM and plant growth promoting microbes), FYM @5t/ha (T<sub>2</sub>), FYM @5t/ha+*Trichoderma* spp. (1:50)(T<sub>3</sub>), FYM @5t/ha+ *Pseudomonas fluorescens* (1:50)(T<sub>4</sub>) and FYM @5t/ha enriched with *Trichoderma* spp.+*Pseudomonas fluorescens* + *Bacillus* spp.)(1:50)(T<sub>5</sub>). The bioformulations that were used for the microorganisms are Bioveer for *Trichoderma viride*, Biomonas for *Pseudomonas fluorescens* and Biozin PTB for the consortia of *Trichoderma viride* + *Pseudomonas fluorescens* + *Bacillus brevis*. The cultivars were planted on 19th November, 2021 and harvested on 24th February (95 days after planting). The soil of the experimental site was sandy loam in texture, acidic in reaction (pH 5.42), medium in bulk density (1.40 g/cm<sup>3</sup>), low in electrical conductivity (0.03 dS/m), high in organic carbon (0.77%), low in available nitrogen (267.00 kg/ha), medium in available phosphorus (22.15 kg/ha) and potassium (140.00 kg/ha). Results from the experiment revealed that there was no significant difference between the two cultivars in most of the growth and yield parameters except for leaf area index, leaf area duration, crop growth rate and total uptake of potassium where “Rongporia” proved to be higher in performance than cultivar “Axomiya”. The growth as well as yield parameters and yield of the cultivars were affected by FYM enriched with plant growth promoting microbes. The growth characters viz., plant height, number of shoots, number of leaves, crop canopy coverage, chlorophyll content, dry weight,

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stolon weight, yield attributing characters viz., tuber dry matter, dry matter yield, total tuber number and yield, total microbial population, and soil parameters viz., organic carbon content and soil microbial biomass carbon were significantly higher where FYM @5t/ha enriched with *Trichoderma* spp.+ *Pseudomonas fluorescens*+ *Bacillus* spp.(1:50)(T<sub>5</sub>) was applied. The same treatment recorded the highest NPK content and uptake. This treatment was at par with treatment where FYM was applied enriched with *Pseudomonas fluorescens*(1:50)( T<sub>4</sub>) in case of plant height, number of shoots, number of leaves, leaf area index, leaf area duration, crop canopy coverage, dry weight, crop growth rate, tuber dry matter, harvest index, nitrogen content and phosphorus uptake. Application of FYM @5t/ha enriched with *Trichoderma* spp.+ *Pseudomonas fluorescens*+ *Bacillus* spp.(1:50)(T<sub>5</sub>) to cultivar “Rongporia” resulted in the highest gross return (₹ 3,15,432/ha), net return (₹ 2,24,932/ha ) and B-C ratio(3.49) compared to all other treatment combinations. This was followed by application of FYM @5t/ha enriched with *Trichoderma* spp.+ *Pseudomonas fluorescens*+ *Bacillus* spp.(1:50)(T<sub>5</sub>) to cultivar “Axomiya” with gross return (₹ 2,42,657/ha), net return (₹ 1,62,157/ha ) and B-C ratio(3.01).

## **Nano Nitrogen Management in Potato (*Solanum tuberosum* L.)**

*Priyabrat Hazarika*

A field experiment entitled “Nano nitrogen management in potato (*Solanum tuberosum* L.)” was conducted at the Instructional-cum-Research (ICR) Farm of the Assam Agricultural University, Jorhat during the rabi season of 2021-22. The objectives of the experiment were to study the growth and yield of potato as influenced by combined application of nano and conventional urea and to determine a suitable dose of nano nitrogen in combination with conventional urea for potato. The treatment comprised of combinations of nano and conventional urea viz., T<sub>1</sub>: RDF (120 kg N/ha, 100 kg P<sub>2</sub>O<sub>5</sub> /ha and 100 kg K<sub>2</sub>O/ha), T<sub>2</sub>: T<sub>1</sub>+ 2 sprays of water at stolon initiation and tuber formation stage, T<sub>3</sub>: T<sub>1</sub>+ 2 spray of nano N @ 4 ml/l at stolon initiation and tuber formation stage, T<sub>4</sub>: T<sub>1</sub>+2 spray of nano N @ 8 ml/l at stolon initiation and tuber formation stage, T<sub>5</sub>: 75% of RDN and full RDF of P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O + 2 spray of nano N @ 4 ml/l at stolon initiation and tuber formation stage, T<sub>6</sub>: 75% of RDN and full RDF of P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O + 2 spray of nano N @ 8ml/l at stolon initiation and tuber formation stage, T<sub>7</sub>: 50% of RDN and full RDF of P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O + 2 spray of nano N @ 4 ml/l at stolon initiation and tuber formation stage, T<sub>8</sub>: 50% of RDN and full RDF of P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O + 2 spray of nano N @ 8 ml/l at stolon initiation and tuber formation stage, T<sub>9</sub>: 25% of RDN and full RDF of P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O + 2 spray of nano N @ 4 ml/l at stolon initiation and tuber formation stage, T<sub>10</sub>: 25% of RDN and full RDF of P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O + 2 spray of nano N @ 8 ml/l at stolon initiation and tuber formation stage. The experiment was laid out in a randomized block design (RBD) with three (3) replications using the potato variety “Kufri Megha”. The soil of the experimental site was sandy loam in texture, acidic in reaction (pH: 5.79), medium in organic carbon content (0.73%) and the status of the available nitrogen (282.44 kg/ha), phosphorus (24.58 kg/ha) and potassium (178.29 kg/ha) was medium. The results revealed that growth, yield attributes and yield of potato were significantly affected by the nano nitrogen management in potato. Among the treatments, the treatment T<sub>7</sub> resulted the highest plant height (56.52 cm), number of leaves per plant (61.00), leaf area index (LAI) (2.34), number of stolon per plant (11.67), stolon weight per plant (60.02 g/plant), dry matter accumulation per plant, number of tuber per plant (8.67), tuber yield per plant (255.45

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g/plant), graded tuber yield per plant and total tuber yield (181.04 q/ha). The haulm recorded the highest content of nitrogen (1.51%), phosphorus (0.43%), potassium (1.25%) and tuber recorded the highest content of nitrogen (1.86%), phosphorus (0.48%), and potassium (1.47%) under the same T<sub>7</sub> treatment. Similarly, the highest uptake of total nitrogen (98.89 kg/ha), phosphorus (26.43 kg/ha) and potassium (78.97 kg/ha) were also recorded under the T<sub>7</sub> treatment. The highest gross return (Rs.362080.00/ha), net return (Rs.218729.00/ha) and benefit cost ratio (2.53) were obtained with the treatment T<sub>7</sub>. Based on the results of the present investigation, it may be concluded that application of 50% of RDN i.e. 60 kg N/ha along with full dose of P<sub>2</sub>O<sub>5</sub> & K<sub>2</sub>O as basal and 2 sprays of Nano N @ 4 ml/l at stolon initiation and tuber formation stage (T<sub>7</sub>) in potato was found to be the best combination of conventional and nano nitrogen for attaining the highest growth, yield attributes, yield, net return and benefit-cost ratio.

## **Effect of Organic Nutrient Management on Fodder Productivity of Perennial Grass During Lean Period**

*Priyanchipriya Bora*

A field experiment entitled “Effect of organic nutrient management on fodder productivity of perennial grass during lean period” was carried out during *Rabi* season on two perennial grasses hybrid napier and congo signal in the year 2011-2022, at the Instructionalcum-Research (ICR) Farm of Assam Agricultural University, Jorhat. The objectives of the experiment were to study, first, the effect of organic nutrient management on fodder productivity and quality of the perennial grass and second, to study the effect of treatments on soil properties and economics of fodder production on lean period. The variety used for the experiment for hybrid napier was CO5 and DBRS7 for congo signal. The experiment was conducted using Randomised Block Design (RBD) with 2x7 treatments and 3 replications. The treatments were as such- T<sub>1</sub>-FYM @ 5T/ha, T<sub>2</sub>-application of jeewamrit @ 500lts/ha with mulch @10t/ha, T<sub>3</sub>-application of jeewamrit at 500lts/ha without mulch, T<sub>4</sub>- FYM@5T/ha basal + application of jeewamrit at 500lts/ha with mulch @10t/ha, T<sub>5</sub>- FYM@5T/ha basal + application of jeewamrit at 500lts/ha without mulch, T<sub>6</sub>- FYM@5t/ha + foliar application of compost tea and T<sub>7</sub>-control (no manure). The experimental site was found to be acidic with pH 5.19, sandy loam, low in organic carbon (0.51%) content, medium in available nitrogen (293.46 kg/ha), low in available phosphorus (19.50 kg/ha) and medium in available potassium (141.56 kg/ha). The results showed that among the different organic inputs, treatment T<sub>4</sub> profoundly impacted the growth, yield, quality parameters as well as the physico-chemical and biological properties of soil of hybrid napier and treatment T<sub>6</sub> profoundly impacted congo signal. Both the treatments produced significantly highest plant height, number of tillers per plant and number of leaves per tiller in respective crops. Treatment T<sub>4</sub> significantly has highest total green fodder yield (705.43q/ha), total dry matter yield (127.50q/ha), crude protein content (12.16%) and total crude protein yield (1461.82 kg/ha) over control in hybrid napier while, treatment T<sub>6</sub> significantly has highest green fodder yield (635.53 q/ha), total dry matter yield (124.14 q/ha), crude protein content (14.20%) and total crude protein yield (1617.08%) over control in congo signal grass.

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The plots with treatment T<sub>4</sub> in hybrid napier and T<sub>6</sub> in congo signal showed highest microbial count (bacterial and fungal) when compared to initial count. Although all the organic treatments maintained the microbial count higher than the initial count. Also, all the organically treated plots maintained the post-harvest available nitrogen, phosphorus, potassium content in soil over control. The highest gross return, net return and benefit cost ratio were obtained in treatment T<sub>4</sub> in hybrid napier (3.72) and treatment T<sub>6</sub> in congo signal (3.42) as compared to all other treatments. The study revealed that application of treatment T<sub>4</sub> and treatment T<sub>6</sub> in respective grasses may be considered economically superior and beneficial for organic cultivation of hybrid napier and congo signal under agro-ecological situation of Assam.

## **Agronomic Biofortification of Dual Purpose Oats (*Avena sativa* L.) with Zinc**

*Priyanka Devi*

A field experiment entitled “Agronomic biofortification of dual purpose oats (*Avena sativa* L.) with zinc” was conducted at the Instructional-cum-Research (ICR) Farm of Assam Agricultural University, Jorhat, during the rabi season in the year 2021-2022. The objective of the experiment was to study the effect of zinc biofortification on yield and quality of dual purpose oats and to study the nutrient uptake and post - harvest soil nutrient status as affected by agronomic biofortification with zinc. The experiment was carried out using the variety ‘Kent’. The investigation was laid out by using the Randomized Block Design (RBD) with 12 treatments and 3 replications. The treatments were as such - Control (RDF: N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O @ 40-20-20 kg/ha) [T1], RDF + soil application of ZnSO<sub>4</sub> @ 5kg/ha [T<sub>2</sub>], RDF + soil application of ZnSO<sub>4</sub> @ 7.5kg/ha [T3], RDF + soil application of ZnSO<sub>4</sub> @ 10kg/ha [T4], RDF + one foliar application of 0.5% ZnSO<sub>4</sub> at 30 DAS [T5], RDF + one foliar application of 0.75% ZnSO<sub>4</sub> at 30 DAS [T6], RDF + two foliar application of 0.5% ZnSO<sub>4</sub> at 30 DAS and 15 days after first cut [T7], RDF + soil application of ZnSO<sub>4</sub> @ 5kg/ha + one foliar application of 0.5% ZnSO<sub>4</sub> at 30 DAS [T8], RDF + soil application of ZnSO<sub>4</sub> @ 5kg/ha + one foliar application of 0.75% ZnSO<sub>4</sub> at 30 DAS [T9], RDF + soil application of ZnSO<sub>4</sub> @ 5kg/ha + two foliar application of 0.5% ZnSO<sub>4</sub> at 30 DAS and 15 days after first cut [T10], RDF + soil application of ZnSO<sub>4</sub> @ 7.5 kg/ha + two foliar application of 0.5% ZnSO<sub>4</sub> at 30 DAS and 15 days after first cut [T11] and RDF + Water spray at 30 DAS and 15 days after first cut [T12]. The site was acidic (pH 5.5), sandy loamy, low in organic carbon (0.46%), medium in available nitrogen (308.93kg/ha), low in available phosphorus (21.36 kg/ha), medium in available potassium (150.75 kg/ ha) and low in available zinc (0.58 mg/kg). It was recorded that treatment T11 greatly influenced the growth, yield, quality and nutrient status of the crop. This treatment significantly increased the plant height, number of tillers/ m<sup>2</sup> and periodic dry matter accumulation. Green fodder yield (75.01q/ha), dry matter yield (28.83 q/ha), grain yield (22.96 q/ha), straw yield (60.84 q/ha), crude protein (16.76% in fodder, 24.19% in grains and 5.04% in straw) and total crude protein yield (1345.12kg/ha) were significantly highest with the treatment. However, treatment T11 decreased the crude fibre significantly and produced

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no significant effect on crude fat. The treatment was also effective in significantly increasing the nitrogen and potassium content and the uptake of nitrogen, phosphorus and potassium by the crop. The phosphorus content was however, non-significant. Similarly, significantly highest zinc content (28.430 mg/kg in fodder, 33.660 mg/kg in grains and 34.670 mg/kg in straw) and its total uptake (370.19 g/ha) were produced by the treatment T11. The plots under treatment T11 had relatively lowest post-harvest soil available nitrogen, phosphorus and potassium content due to their removal by the crop. Furthermore, application of zinc was effective in raising the available soil zinc status at harvest with the treatment T4 without significantly altering the soil physico – chemical of the soil. The treatment T<sub>11</sub> increased the gross return (₹ 98,537), net return (₹65,558) and benefit cost ratio (2.99) over other treatments. Thus considering the yield of grain, green fodder, crude protein and nutrient content, treatment T11 may be considered economically viable for biofortification of dual purpose oats that suits soil and climatic condition of Assam.

# **Effect of Mulching on Weed Management, Growth and Yield of Rainfed Potato (*Solanum tuberosum* L.)**

*Priyanka Kakati*

A field experiment entitled “Effect of mulching on weed management, growth and yield of rainfed potato (*Solanum tuberosum* L.)” was carried out during rabi, 2021-22 at P.G Experimental Field, Department of Agronomy, B.N College of Agriculture, AAU, Biswanath Chariali with the objectives of (i) Assess the effect of mulching on weed population and growth in rainfed potato, (ii) Evaluate the effect of mulching on growth and yield of rainfed potato. The experiment was arranged in a randomized block design with three replication and eleven treatments viz., Plastic mulching before planting, Straw mulching after planting, Water hyacinth mulching after planting, Weed mulching after planting, Plastic mulching before planting + Hand weeding at 45 DAP, Straw mulching after planting + Hand weeding at 45 DAP, Water hyacinth mulching after planting + Hand weeding at 45 DAP, Weed mulching after planting + Hand weeding at 45 DAP, Earthing up at 25 and 45 DAP, Weed free check, Weedy (control). The results from the present investigation revealed that weed control methods had significant impact on suppression of weed population and weed dry weight, resulted in increased weed control efficiency. Among the weed control methods, lowest weed population was recorded in „Water hyacinth mulching after planting + Hand weeding at 45 DAP” in all growth stages except 20 DAP where „Plastic mulching before planting + Hand weeding at 45 DAP” was comparable with „Water hyacinth mulching after planting + Hand weeding at 45 DAP”. Lowest weed dry weight and highest weed control efficiency were recorded under „Water hyacinth mulching after planting + Hand weeding at 45 DAP” at 40 DAP, 60 DAP and at harvest, however, at 20 DAP lowest weed dry weight and highest weed control efficiency were found under „Plastic mulching before planting + Hand weeding at 45 DAP”. All the phenological parameters except days to seedling emergence were found statistically at par in „Plastic mulching before planting + Hand weeding at 45 DAP and „Water hyacinth mulching after planting + Hand weeding at 45 DAP”. Highest plant height (27.67cm, 59.89cm and 63.75 cm), branches plant-1 (6.78, 9.65 and 9.91) and leaves plant-1 (42.00, 59.56, and

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60.90) at 30DAP, 60DAP and at harvest, respectively were observed in „Water hyacinth mulching after planting + Hand weeding at 45 DAP“. Weed control methods had no significant effect on Chlorophyll Content Index. LAI (0.94 and 3.16 at 30 DAP and 60 DAP, respectively) and Crop dry weight (5.49, 62.78, 97.98 g plant-1 at 30 DAP, 60 DAP and at harvest, respectively) were found highest in „Water hyacinth after planting + Hand weeding at 45 DAP“. Under the same treatment crop growth rate and relative growth rate were also recorded maximum at different crop growth stages. Tubers plant-1 (15.77), tuber weight (59.22g), tuber diameter (6.22cm) showed the best results under „Water hyacinth mulching after planting + Hand weeding at 45 DAP“ followed by „Weed mulching after planting + Hand weeding at 45 DAP“. Lowest green tubers plant-1 (1.06), small tuber plant-1 (2.18) and highest medium and big tubers plant-1 (9.52 and 3.78, respectively) were recorded under „Water hyacinth mulching after planting + Hand weeding at 45 DAP“. Among the weed control methods, „Water hyacinth mulching after planting + Hand weeding at 45 DAP“ recorded highest tuber yield (201.00 kg ha-1 ) and lowest weed index (10.41%) with highest Gross return (Rs 402000.00 ha-1 ), Net return (Rs 248239.00 ha-1 ), B:C ratio (2.61) and Economic Efficiency (Rs 2920.46 ha-1 day-1 ). The effect of weed control methods on post harvest soil properties (Organic carbon %, pH, N, P) were found to be non significant except for available potassium. Weed control methods showed significant effect on soil moisture and soil temperature at some growth period. Highest soil moisture and soil temperature were recorded in „Plastic mulching before planting“ in rabi potato. „Water hyacinth mulching after planting + Hand weeding at 45 DAP“ was found best for suppressing weed population and growth and resulted in superior growth and crop yield including higher B:C under rainfed conditions.

## **Drip fertigation in broccoli (*Brassica oleracea* var. *italica*)**

*Pujashree Kalita*

A field experiment was conducted at Instructional-cum-Research Farm, Assam Agricultural University, Jorhat in *rabi* season of 2019-20 and 2020-21 to study the “Drip fertigation in broccoli (*Brassica oleracea* var. *italica*)”. The experiment consisted of four irrigation levels *viz.*, I<sub>1</sub>:1.20 ETc (drip at 120% ETc), I<sub>2</sub>: 1.00 ETc (drip at 100% ETc), I<sub>3</sub>:0.8 ETc (drip at 80% ETc) and I<sub>4</sub>:0.60 ETc (drip at 60% ETc) and four fertilizer levels *viz.*, F<sub>1</sub>:100% RD of N, P and K through drip, F<sub>2</sub>:75% RD of N, P and K through drip, F<sub>3</sub>:50% RD of N, P and K through drip and F<sub>4</sub>: No fertilizer. The experiment was laid out in Factorial Randomised Block Design (FRBD) with three replications. The soil of the experiment site was sandy loam in texture, moderately acidic in reaction, medium in organic carbon, nitrogen, phosphorus and potassium content. The broccoli hybrid Green magic was transplanted on 18 December 2019 and 21 December 2020, respectively, for both the years of study and harvested from 09-21 March 2020 and 15-24 March 2021, respectively.

The results revealed that irrigation level I<sub>1</sub>:1.20 ETc (drip at 120% ETc) recorded significantly highest growth and yield parameters like plant height, number of leaves per plant, plant spread, head yield, biological yield, total head yield and harvest index which was *at par* with treatment I<sub>2</sub>:1.0 ETc (drip at 100% ETc) in both the years of study and in pooled. However, the days to head initiation and maturity and IWUE were highest with I<sub>4</sub>: 0.6 ETc (Drip at 60% ETc) and stalk diameter and head diameter was recorded highest with I<sub>2</sub>: 1.0 ETc (drip at 100 % ETc) which was *at par* with treatment I<sub>1</sub>:1.20 ETc (drip at 120% ETc). Application of drip irrigation at 120% ETc (I<sub>1</sub>) recorded the highest plant water content and relative leaf water content at all the growth stages in both the years of study. The highest N, P, K content and uptake in head, stem and leaves along with total uptake by plant, available N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O content in soil after harvest were recorded by application of I<sub>1</sub>:1.20 ETc (drip at 120% ETc) which was *at par* with the treatment I<sub>2</sub>:1.0 ETc (drip at 100% ETc). In pooled analysis, similar trend was observed.

Similarly, treatment F<sub>1</sub>:100% RD of NPK through drip which was *at par* with F<sub>2</sub>: 75% RD of NPK through drip in both the years of study and in pooled recorded

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highest growth and yield attributes along with the highest N, P, K content and uptake in head, stem and leaves and total uptake by the plant accompanied by highest available N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O content in soil after harvest of the crop.

The two years study on different levels of drip irrigation and fertilizer was capable to show significant response on growth and yield of broccoli. Drip irrigation at 120% ET<sub>c</sub> with 100% RD of NPK showed maximum net return and BC ratio recording the values of Rs 392606 and 4.95, respectively, followed by drip irrigation at 100 % ET<sub>c</sub> + 75% RD of NPK with respective values of Rs 295286 and 4.01. Thus, from the resource (water and fertilizer) conservation point of view, drip irrigation at 100 % ET<sub>c</sub> in combination with 75% RD of NPK may be considered optimum for broccoli crop in Assam.

## **Agronomic Biofortification of Zinc for Enhancing Productivity and Quality of Rye Grass (*Lolium multiflorum* L.)**

*Rahul Saikia*

A field experiment entitled “Agronomic biofortification of zinc for enhancing productivity and quality of rye grass (*Lolium multiflorum* L.)” was carried out during the rabi season in the year 2021-2022, at the Instructional-cum-Research (ICR) Farm of Assam Agricultural University, Jorhat. The objective of the experiment was to study the effect of zinc application on growth, yield and quality of rye grass and to study the nutrient uptake and post-harvest nutrient status in soil as affected by the zinc application in rye grass. The study was conducted using the ‘Makhan grass’ variety. The experiment was carried out by using the Randomized Block Design (RBD) with 12 treatments and 3 replications. The treatments were as such – RDF: N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O @ 60-30- 30 kg/ha [T1], RDF + 5 kg ZnSO<sub>4</sub> /ha [T2], RDF + 10 kg ZnSO<sub>4</sub> /ha [T3], RDF + 15 kg ZnSO<sub>4</sub> /ha [T4], T2 + one foliar application of 0.5% ZnSO<sub>4</sub> (at 45 DAS) [T5], T3 + one foliar application of 0.5% ZnSO<sub>4</sub> (at 45 DAS) [T6], T4 + one foliar application of 0.5% ZnSO<sub>4</sub> (at 45 DAS) [T7], T2 + two foliar application of 0.5% ZnSO<sub>4</sub> (1st at 45 DAS and 2nd at 15 days after first cut) [T8], T3 + two foliar application of 0.5% ZnSO<sub>4</sub> (1st at 45 DAS and 2nd at 15 days after first cut) [T9], T4 + two foliar application of 0.5% ZnSO<sub>4</sub> (1st at 45 DAS and 2nd at 15 days after first cut) [T10], RDF + Water spray at 45 DAS [T11] and RDF+ Water spray (1st at 45 DAS and 2nd at 15 days after first cut) [T12]. The experimental site was acidic in reaction (pH 5.49), sandy loam in texture, low in organic carbon (0.45%), medium in available nitrogen (306.92 kg/ha), low in available phosphorus (21.66 kg/ha), medium in available potassium (150.95 kg/ ha) and low in available zinc (0.58 mg/kg). The results showed that treatment T10 profoundly impacted the growth, yield, quality parameters as well as nutrient status of the crop. This treatment produced significantly highest plant height, number of tillers/m<sup>2</sup>, number of leaves/plant and periodic dry matter accumulation. The total green fodder yield (373.20 q/ha), total dry matter yield (77.66 q/ha), crude protein (13.214%, 14.439% and 12.018% at first, second and third cut, respectively) and total crude protein yield (1028.19 kg/ha) was also significantly highest by this treatment. However, crude fibre

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(%) was significantly decreased by treatment T10 and no significant effect on crude fat (%) was observed. The treatment T10 significantly increased the nitrogen and potassium content as well as their uptake by the crop. The phosphorus uptake was also significantly highest with the same treatment without significantly affecting its content. Likewise, in the treatment T10, significantly highest zinc content (32.962 mg/kg, 31.960 mg/kg and 30.362 mg/kg in first, second and third cut, respectively) and its total uptake (244.93 g/ha) was obtained. The plots with treatment T10 had relatively lowest post-harvest soil nitrogen, phosphorus and potassium content. Moreover, application of zinc was effective in raising the post-harvest soil zinc content with the treatment T10 without significantly altering the soil physico-chemical properties. The gross return (Rs.75,386), net return (Rs.46,702) and benefit-cost ratio (2.63) was obtained in the treatment T10 which was found to be highest as compared to all other treatments. Therefore, considering the yield of green fodder and its crude protein, treatment T10 may be considered economically superior for biofortification of rye grass that suits soil and climatic condition of Assam.

## **Forage production potentiality of cowpea-oat cropping system under organic nutrient management**

*Raktim Bhagawati*

A field experiment titled “Forage production potentiality of cowpea-oat cropping system under organic nutrient management” was conducted during kharif and rabi seasons of 2019-20 and 2020-21 at the Instructional-Cum-Research farm of Assam Agricultural University, Jorhat, Assam. The experiment consisting of 13 treatments viz., 100% RDN through inorganic fertilizers (T1), 100% RDN through FYM (T2), 75% RDN through FYM + 25% RDN through vermicompost (T3), 75% RDN through FYM+ 25% RDN through enriched compost (T4), 50% RDN through FYM+ 50% RDN through vermicompost (T5), 50% RDN through FYM + 50% RDN through enriched compost (T6), 75% RDN through FYM (T7), 50% RDN through FYM + 25% RDN through vermicompost (T8), 50% RDN through FYM + 25% RDN through Enriched compost (T9), 25% RDN through Farm yard manure + 50% RDN through vermicompost (T10), 25% RDN through FYM + 50% RDN through enriched compost (T11), 25% RDN through FYM + 25% RDN through vermicompost + 25% RDN through poultry manure top dressed at 30 DAS (T12), 25% RDN through FYM + 25% RDN through enriched compost + 25% RDN through poultry manure top dressed at 30 DAS (T13) was laid out in randomised block design with three replications. The soil of the experimental site was sandy loam in texture, acidic (pH 5.54) in reaction, medium in organic carbon (0.65 %), available N (252.76 kg ha<sup>-1</sup>), low in P<sub>2</sub>O<sub>5</sub> (20.83 kg ha<sup>-1</sup>) and medium in K<sub>2</sub>O (220.67 kg ha<sup>-1</sup>). The experimental findings revealed that application of 25% RDN through FYM + 25% RDN through enriched compost + 25% RDN through poultry manure top dressed at 30 DAS (T13) registered the highest values for most of the growth characters viz., plant height, number of leaves per plant, leaf area and leaf-stem ratio of the cowpea crop. The maximum green fodder and dry matter yields of cowpea were recorded at T13 followed by T4 during both the years of experimentation. Quality parameters of cowpea viz., crude protein yield, ash and total carbohydrate contents were significantly influenced by organic nutrient management practices with the highest values at T13 during both the years. In case of succeeding oat

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crop, the maximum response in growth characters as well as green fodder and dry matter yields were reflected at T13 followed by T4. Similar trend followed in case of quality parameters in oat crop. The total green fodder yield of the cowpea-oat system was highest at T13 followed by T4 during both the years of trial. Soil analysis data after completion of sequence also revealed higher values of available N at T4 followed by T13. The available P and K status, soil organic carbon, soil microbial biomass carbon in soil after sequence was found to be highest at T13 followed by T4 in both the years. No significant changes in soil pH were noticed during both the years of experimentation. Organic nutrient management practices significantly increased the Zn status of soil with the highest value of 0.88 and 0.84 mg kg<sup>-1</sup> soil at T13 in both the years of trial. Soil biological character was found to be statistically superior in respect of microbial biomass carbon (332.29 and 331.49 µg g<sup>-1</sup> soil) at T13 followed by T4 in 2019-20 and 2020-21, respectively. Although, the highest B:C ratio of 3.63 was observed at T1, but among the different organic nutrient management practices, the highest B:C ratio of 2.75 was obtained at T13 with highest net return of Rs. 108263.80. Considering the positive effects of organic nutrient management on growth and yield of cowpea and oat in sequence and soil health, T13 was found the best to reap good economic yield, system productivity, monetary return with sustained soil health.

## **Integrated weed and nutrient management in summer maize**

*Ravindar Saini*

Abstract A field experiment entitled “Integrated weed and nutrient management in summer maize (*Zea mays*)” was conducted at the Instructional-cumResearch (ICR) Farm, Assam Agricultural University, Jorhat during the summer season of the year 2020 to evaluate the effects of integrated weed and nutrient management on weed and growth, yield attributes and yield of summer maize. The experiment was laid out in factorial randomized block design and replicated thrice. The treatment consisted of three nutrient management practice viz., 100% RDF (N1) ; N1+ 25 kg ZnSO<sub>4</sub>/ha (N2) and 75 % RDN and 100 % P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O through chemical fertilizer(CF) + 25 % N through vermicompost + 25 kg ZnSO<sub>4</sub>/ha (N3) and four weed management practices viz., weedy check (WM1), live mulching with cowpea (WM2), WM2 + hand weeding at 25 and 45 DAS (WM3) and Atrazine 500g+Pendimethalin 500g/ha followed by hand weeding at 45 DAS (WM4).The soil of the experimental site was sandy loam in texture, acidic in reaction, medium in organic carbon (0.71%), low in available N (158.60 kg/ha) and medium in available P<sub>2</sub>O<sub>5</sub> (22.87 kg/ha) and K<sub>2</sub>O (162.55 kg/ha) and low in available Zn (0.64 ppm). The crop was sown on 7th March, 2020 and harvested on 10th June, 2020. Experimental findings revealed that the different INM practices significantly affected the growth parameters and yield and yield attributes of summer maize. The maximum values of growth parameters were recorded in the treatment involving application of 75 % RDN and 100 % P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O through CF + 25 % N through VC + 25 kg ZnSO<sub>4</sub>/ha (N3). Similarly, yield and yield attributing characters viz., weight of cob with and without husk, length of cob without husk, number of rows per cobs, grain per row, grain per cob, 1000 grain weight, shelling percentage, grain (23.76 q/ha) and stover (74.55 q/ha) yield and nutrient uptake was recorded highest in the N3 treatment. The density and dry matter production by the weeds were significantly affected by the different INM practices and the lowest values were recorded with the N3 treatment. The growth, yield and yield attributing parameters of maize as well as the density and dry matter production by the weeds were significantly affected by the different weed management practices. Pre emergence application of Atrazine 500g + Pendimethalin

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500g/ha followed by hand weeding at 45 DAS (WM4) resulted the highest values of yield and lowest values of weed density and dry matter. The highest grain (21.77 q/ha) and stover (71.12 q/ha) yield were recorded in the treatment WM4. The interaction effects of different nutrient and weed management practices were found not significant. The economic study revealed that the highest gross return (₹.1,03816.00/ha), net return (₹.67,956.00) and B: C (1.90) were recorded from the treatment combination N3WM4.

## **Performance of ryegrass (*Lolium multiflorum*) under integrated nutrient management**

*Richa Saikia*

An experiment entitled “Performance of ryegrass (*Lolium multiflorum*) under integrated nutrient management” was carried out at Instructional-cum-Research (ICR) Farm of Assam Agricultural University, Jorhat during the rabi season of 2019-20. The experiment was laid out in Randomized Block Design (RBD), replicated thrice with eight treatments viz., T1: Control (No fertilizer), T2: 100% RDF (inorganic), T3: 75% RDF (inorganic), T4: 50% RDF (inorganic), T5: 75% RDN (inorganic) + 25% vermicompost (organic), T6: 75% RDN (inorganic) + 25% FYM (organic), T7: 50% RDN (inorganic) + 50% vermicompost (organic) and T8: 50% RDN (inorganic) + 50% FYM (organic). The soil of the experimental site was sandy loam in texture, acidic in reaction (pH 5.42), medium in organic carbon (0.52%) and available K<sub>2</sub>O (155.45kg/ha) and low in available N (235.62 kg/ha) and available P<sub>2</sub>O<sub>5</sub> (20.12 kg/ha). The results revealed that the highest growth parameters like plant height, number of tillers/m<sup>2</sup>, dry matter accumulation as well as total green forage yield (307.69 q/ha) and dry matter yield (62.94 q/ha) were recorded under treatment T2 (100% RDF), which was closely followed by treatment T5 (75% RDN + 25% vermicompost) and T6 (75% RDN + 25% FYM). Significantly higher quality parameters like crude protein and crude fat content in all the three cuts were recorded under treatment T2, which was at par with treatment T5, T6 and T7. The crude fibre content was the highest under treatment T1 (control) where no fertilizer was applied. Similarly, significantly higher total crude protein yield (6.03 q/ha) was recorded under treatment T2 which was at par with treatment T5 while crude fibre yield was the highest (8.25 q/ha) under T2 but was at par with treatment T5 and T6. The total N, P and K uptake by the crop was recorded significantly higher under treatment T2 with 96.54, 15.18 and 57.05 kg/ha, respectively, followed by treatment T5 which was at par with T2. The maximum soil organic carbon was recorded under treatment T8 (50% RDN + 50% FYM) which was at par with treatment T6 and T7. The highest available N, P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O in soil was recorded under treatment T5 (75% RDN + 25% vermicompost). From economic point of view, the highest B-C ratio (1.71) was recorded under T2 (100% RDF) followed by treatment T6 (1.62). Thus, considering the yield and quality parameters as well as soil health and economic feasibility, treatment T6

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with 75% RDN (inorganic) + 25% FYM (organic) could be considered as the best nutrient management practice in ryegrass under the prevailing climatic condition of Assam. However, this practice needs further experimentation and studies for at least two more years to derive a valid conclusion before putting forward a recommendation to the farming community.

## **Effect of Plant Residue and Extract on Weed Management in Rabi Maize (*Zea mays*)**

*Rimpa Das*

A field experiment was conducted at Instructional-Cum-Research farm, Assam Agricultural University, Jorhat, during *rabi*, 2021-22 on maize titled “Effect of plant residue and extract on weed management in rabi maize (*Zea mays*)”. The experiment was laid out in a randomized block design with each treatment replicated thrice. The treatments consisted of W1- Weedy check, W2- Weed free check, W3- Rice straw mulch @ 2 t/ha, W4- *Lantana camara* extract (5%) 2 sprays at 15 and 30 DAS, W5- *Lantana camara* extract (10%) 2 sprays at 15 and 30 DAS, W6- *Lantana camara* extract (15%) 2 sprays at 15 and 30 DAS, W7- Mixture of *Lantana camara* + rice straw extract (5%) 2 sprays at 15 and 30 DAS, W8- Mixture of *Lantana camara* + rice straw extract (10%) 2 sprays at 15 and 30 DAS, W9- Mixture of *Lantana camara* + rice straw extract (15%) 2 sprays at 15 and 30 DAS, W10- *Lantana camara* extract (5%) spray at 15 DAS followed by one mechanical weeding at 30 DAS, W11- *Lantana camara* extract (10%) spray at 15 DAS followed by one mechanical weeding at 30 DAS, W12- *Lantana camara* extract (15%) spray at 15 DAS followed by one mechanical weeding at 30 DAS, W13- Metribuzin 0.50 kg/ha pre-emergence followed by *Lantana camara* extract (5%) spray at 30 DAS, W14- Metribuzin 0.50 kg/ha pre-emergence followed by *Lantana camara* extract (10%) spray at 30 DAS, W15- Metribuzin 0.50 kg/ha pre-emergence followed by *Lantana camara* extract (15%) spray at 30 DAS and W16- Metribuzin 0.50 kg/ha pre-emergence. The soil texture of the experimental site was sandy loam. The available N in the soil was low (158.2 kg/ha), whereas available P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O were medium (24.78 and 168.3 kg/ha, respectively). Among all these treatments *Lantana camara* extract (15%) spray at 15 DAS followed by one mechanical weeding at 30 DAS (W12) enhanced all the plant growth parameters, yield parameters and nutrient uptake by improving weed control efficiency and weed control index thereby, increasing grain and cob yield that resulted in lower weed index. In the experimental site, monocot weeds such as *Panicum repens*, *Cynodon dactylon*, *Cyperus rotundus* and *Commelina diffusa* and dicot weeds viz. *Alternanthera sessilis*, *Amaranthus viridis*, *Oxalis debilis*, *Oxalis corniculata*, *Ageratum haustonianum*, *Ageratum conizoides*, *Crassocephalum crepedioides* and *Polygonum plebeium* were

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predominant. Out of total weeds respective per cent of monocot and dicot weeds were 66.92 and 33.08; 48.08 and 51.93; 61.23 and 38.78 at 30, 60 and 90 DAS. Out of these, all the monocot weed densities except *Cyperus rotundus* and all the 6 dicot weed densities except *Crassocephalum crepedioides* were significantly reduced under W12 i.e. *Lantana camara* extract (15%) spray at 15 DAS followed by one mechanical weeding at 30 DAS as compared to weedy check (W1). Moreover, the same treatment significantly decreased monocot, dicot and total weed density by 30.85, 59.50 and 39.01; 56.82, 98.05 and 69.94; 47.61, 97.91 and 58.99 per cent, respectively and dry matter by 45.82, 64.30 and 47.92; 64.45, 96.73 and 68.43; 43.81, 97.12 and 51.80 per cent, respectively at 30, 60 and 90 DAS resulting in higher weed control efficiency and weed control index which was at par with W10 (*Lantana camara* extract (5%) spray at 15 DAS followed by one mechanical weeding at 30 DAS) and W11 (*Lantana camara* extract (10%) spray at 15 DAS followed by one mechanical weeding at 30 DAS). Similarly, plant growth parameters viz. plant height, leaf area index, root weight, root length, root-shoot ratio and dry matter accumulation was higher under *Lantana camara* extract (15%) spray at 15 DAS followed by one mechanical weeding at 30 DAS (W12) as compared to weedy check which consequently improved the yield parameters such as weight of cob with husk, weight of cob without husk, grain/pith ratio, numbers of grains per row, number of grains per cob and grain weight per cob by 86.99, 62.15, 40.54, 36.35, 40.37 and 70.27 per cent, respectively over weedy check and significantly increased cob yield, grain yield and stover yield by 42.38, 79.88 and 25.16 per cent, respectively over weedy check resulting in lower weed index (10.15%). The same treatment recorded higher gross return (84614.67 /ha), net return (55769.07 /ha) and B-C ratio of 1.93 as compared to other treatments.

## **Recent Techniques of Nitrogen Management in Wet Direct Seeded Sali Rice (*Oryza sativa* L.)**

*Santanu Kaushik Borah*

A field experiment was carried out at Instructional cum Research (ICR) farm, AAU, Jorhat on the topic —Recent techniques of nitrogen management in wet direct-seeded *sali* rice to study the performance of direct seeded *sali* rice under different nitrogen management practices and to assess the mid-season nitrogen dose through green seeker, LCC and nano nitrogen during kharif season of 2021. The treatment of the experiment consisted of ten different nitrogen management techniques viz., Control (No nitrogen) (T<sub>1</sub>), 30 kg N/ha as basal + 15 kg N/ha at active tillering + 15 kg N/ha at PI (T<sub>2</sub>), no basal N + N application @ 2ml/l through nano-urea at 21, 35 and 50 DAS (T<sub>3</sub>), no basal N + 15 kg/ha N through LCC when LCC ≤ 5 from 21 DAS (T<sub>4</sub>), 20 kg N/ha as basal + 15 kg/ha N through LCC when LCC ≤ 5 from 21 DAS (T<sub>5</sub>), no basal N + 15 kg/ha N through LCC when LCC ≤ 5 twice starting from 21 DAS + rest green seeker guided (T<sub>6</sub>), 20 kg N/ha as basal + 15 kg/ha N through LCC when LCC ≤ 5 twice starting from 21 DAS + rest green seeker guided (T<sub>7</sub>), No basal N + 20 kg N/ha at 21 DAS + green seeker guided (T<sub>8</sub>), 20 kg N/ha basal + 20 kg N/ha at 21 DAS + green seeker guided (T<sub>9</sub>), 120 kg N/ha applied as per recommended method (60kg basal+ 30kg at active tillering + 30kg at PI) (T<sub>10</sub>). The experiment was laid out in randomized block design (RBD) with three replications. The soil of the experimental site was sandy loam with acidic in soil reaction (pH 5.5), medium in organic carbon (0.59%), available nitrogen (287.62 kg ha<sup>-1</sup>) and low in available P<sub>2</sub>O<sub>5</sub> (21.5 kg ha<sup>-1</sup>), available K<sub>2</sub>O (116.33 kg ha<sup>-1</sup>), available sulfur (14.06 kg ha<sup>-1</sup>) and DTPA Zn (1.46 kg ha<sup>-1</sup>). The weather parameters were also studied during the experiment period where a total of 563.00 mm rainfall was observed. The rice variety —Ranjit Sub11 was sown on 16 July, 2021 and harvested on 30th November, 2021. The results of the experiment revealed that application of 20 kg N/ha as basal + 15 kg/ha N through LCC when LCC ≤ 5 twice starting from 21 DAS + rest green seeker guided (T<sub>7</sub>) resulted in the highest growth parameters in all growth stages, physiological parameters like chlorophyll content, stomatal index yield attributing parameters, grain yield (48.75 q ha<sup>-1</sup>) and straw yield (63.58 q ha<sup>-1</sup>) and harvest index. Besides, 120 kg N/ha applied as per recommended method (60 kg basal+ 30kg at active tillering + 30kg at PI) (T<sub>10</sub>) significantly influenced

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all the growth parameters at 30DAS. Significantly higher uptake of nitrogen, phosphorus and potassium in grain, straw and total uptake by wet direct-seeded *sali* rice was recorded in the treatment consisting of application of 20 kg N/ha as basal + 15 kg/ha N through LCC when LCC  $\leq 5$  twice starting from 21 DAS + rest green seeker guided (T<sub>7</sub>). In terms economics, T<sub>7</sub> resulted in highest gross return (₹ 134420.83 ha<sup>-1</sup>, net return (₹ 89824.43 ha<sup>-1</sup>) and B:C (2.01), followed by treatment consisted of application of 20 kg N/ha basal + 20 kg N/ha at 21 DAS + green seeker guided (T<sub>9</sub>) with gross return (₹ 128158.75 ha<sup>-1</sup>), net return (₹ 83714.25 ha<sup>-1</sup>) and B:C (1.88).

## **Response of hybrid maize (*Zea mays* L.) to integrated nutrient management under different microclimatic regimes**

*Tapan Gogoi*

A field experiment entitled “Response of hybrid maize (*Zea mays* L.) to integrated nutrient management under different microclimatic regime” was conducted at Instructional-cum-Research (ICR) Farm, Assam Agricultural University, Jorhat during summer season of 2020 and 2021 with a view to study the effect of microclimatic regime and integrated nutrient management in maize and also the nutrient uptake by the crop and its availability in soil after harvest. The experiment was laid out in a split plot design with three replications. The treatments consisted of three microclimatic regimes viz., M1: 15th February, M2: 1st March and M3: 15th March and four INM viz., N1: 100% RDF (60-40-40 kg/ha) N2: 75% of RDN as inorganic + 25% RDN as vermicompost, N3: 75% of RDN as inorganic + 25% RDN as FYM and N4: 75% of RDN as inorganic + 25 % RDN as enrich compost. The soil of the experimental site was sandy loam in texture, acidic in reaction (pH 5.12 and 5.18), medium in organic carbon (0.65 % and 0.71 %), available P<sub>2</sub>O<sub>5</sub> (22.68 kg/ha and 22.87 kg/ha) and available K<sub>2</sub>O (144.50 kg/ha and 147.60 kg/ha) while low in available N (229.47 kg/ha and 221.32 kg/ha) in 2020 and 2021 respectively. Experimental findings revealed that different microclimatic regime significantly influenced the growth parameters, yield attributing characters, kernel and stover yield, harvest index and uptake of N, P and K by maize. Among the different microclimatic regimes, crop sown on 15th March resulted in significantly higher values in almost all the growth characters (viz., per cent plant emergence, plant height, leaf area index, dry matter production per plant, crop growth rate, relative growth rate) as compare to the first date of sowing in both the years. Crop sown on 15th March recorded highest values in respect of yield attributing characters like number of kernel rows per cob, kernels per row, number of kernels per cob, weight of cob with husk and weight of cob without husk. Cob yield with husk and cob yield without husk were also significantly higher in 15th March as compared to 15th February sowing in both the years. The highest kernel yield was obtained in 15th March sowing (40.72 kg/ha and 41.30 kg/ha in 2020 and 2021 respectively), which was at par with

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crop sown on 1<sup>st</sup> March (39.37 kg/ha and 40.28 kg/ha) and significantly higher than 15<sup>th</sup> February sowing. The highest stover yield was also obtained in 15<sup>th</sup> March sowing (79.83 kg/ha and 80.42 kg/ha in 2020 and 2021, respectively). Harvest index was significantly higher in 15<sup>th</sup> March (33.82 % and 33.90 %) in 2020 and 2021 and was at par with crop sown on 1<sup>st</sup> March. The uptake of N, P, K by kernel and stover of maize and total uptake were also highest in 15<sup>th</sup> March sowing in both the years but N uptake by kernel, stover and total uptake remain statistically at par with 1<sup>st</sup> March. The effect of microclimatic regime on available N, P and K content in soil after harvest of the crop was found to be nonsignificant. All the integrated nutrient management practices were better as compared to recommended doses of fertilizers (RDF) in terms of growth, yield attributes and yield. Application of 75 % of RDN as inorganic + 25 % RDN as enrich compost (N4) gave significantly higher value in respect of growth parameters studied viz., plant height, leaf area index, dry matter production per plant, crop growth rate, relative growth rate than recommended doses of fertilizers in both the years and remain at par with 75% of RDN as inorganic + 25 % RDN as vermicompost (N2). Among the different integrated nutrient management practices, 75 % of RDN as inorganic + 25 % RDN as enrich compost (N4) proved superior in terms yield attributing characters like number of kernel rows per cob, kernels per row, number of kernels per cob, weight of cob with and without husk. Cob yield with and without husk were significantly higher in 75 % of RDN as inorganic + 25 % RDN as enrich compost (N4) than RDF, but remain at par with 75 % of RDN as inorganic + 25 % RDN as vermicompost (N2). During both the years of experiment, the kernel yield (41.33 kg/ha and 42.55 kg/ha), stover yield (80.00 kg/ha and 80.78 kg/ha) and harvest index (34.79 % and 34.47 %) were found to be significantly higher in 75 % of RDN as inorganic + 25 % RDN as enrich compost (N4) as compared to RDF which was statistically at par with 75 % of RDN as inorganic + 25 % RDN as vermicompost (N2). No treatment differences were observed in respect of number of cob per plant, length of cob without husk, 1000 kernel weight, shelling percentage and N, P, K content in grain and stover due to different integrated nutrient management. However, the available N and K content in soil after harvest of the crop were found to be significantly higher in the control over other treatments. From the economic analysis, it has found that crop sown on 15<sup>th</sup> March recorded the highest gross return (Rs 89,576.67 and Rs 90,860.00), net return (Rs 62,000.17 and Rs 63,283.50) and BC ratio (2.35 and 2.40) in 2020 and 2021, respectively. In case of integrated nutrient management practices, the treatment combination of 75 % of RDN as inorganic + 25 % RDN as enrich compost (N4) recorded maximum gross return (Rs 90,933.33 and Rs 93,622.22) and net return (Rs 62,097.33 and Rs 64,786.22) in 2020 and 2021, respectively.

# **Effect of Integrated Nutrient Management Studies on Growth and Yield of Fodder Maize (*Zea mays* L.)**

*Vijay Singh*

A field experiment entitled “Effect of integrated nutrient management studies on growth and yield of fodder maize (*Zea mays* L.)” was carried out at Instructional-cumResearch (ICR) farm, Assam Agricultural University, Jorhat during rabi season, 2021- 2022 to find out the effect of different INM treatments on the growth and yield of fodder maize and to study the nutrient uptake maize at harvest. The experiment was laid out in randomized block design with eleven treatments and replicated thrice. The treatments consisted of both organic and inorganic sources of nutrients viz., T<sub>1</sub> [Absolute control], T<sub>2</sub> [75% RDF], T<sub>3</sub> [60-30-30 kg/ha NPK (100% RDF)], T<sub>4</sub> [FYM @4t/ha], T<sub>5</sub> [FYM @6t/ha], T<sub>6</sub> [75% RDF + FYM @4t/ha], T<sub>7</sub> [75% RDF + FYM @6t/ha], T<sub>8</sub> [75% RDF + FYM @4t/ha + *Azotobacter* (250g/10kg of seeds) + PSB], T<sub>9</sub> [75% RDF + FYM @6t/ha + *Azotobacter* (250g/10kg of seed inoculation) + PSB], T<sub>10</sub> [100% RDF + FYM @4t/ha + *Azotobacter* (250g/10kg of seed inoculation) + PSB] and T<sub>11</sub> [100% RDF + FYM @6t/ha + *Azotobacter* (250g/10kg of seed inoculation) + PSB]. The soil of the experimental site was sandy loam in texture, acidic in nature (pH 4.96), medium in organic carbon (0.72%), low in available N (157.7 kg/ha), medium in available P<sub>2</sub>O<sub>5</sub> (25.50 kg/ha) and medium in K<sub>2</sub>O (172.10 kg/ha). Nitrogen is applied in two equal split doses, one at the time of sowing and at tasseling. Seeds of fodder maize variety African tall were sown on 1st November, 2021 and harvested on 3rd of February, 2022. The experimental findings revealed that INM practices influenced both the growth and yield attributing characters of fodder maize. Application of 100% RDF + FYM @6t/ha + *Azotobacter* +PSB (T<sub>11</sub>) recorded the highest values for all the growth parameters. Similarly, the yield parameters like green forage yield (q/ha) and dry matter yield (q/ha) and quality parameters viz., nutrient (N, P and K) content (%) and uptake (kg/ha) at harvest, crude protein content (%) and crude protein yield (q/ha) was observed to be highest under the treatment 100% RDF + FYM @6t/ha + *Azotobacter* + PSB (T<sub>11</sub>) which was found at par with 100% RDF + FYM @4t/ha + *Azotobacter*

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+PSB (T<sub>10</sub>). However, soil parameters (pH and soil organic carbon) were found non-significant but available N, available P and available K in soil was recorded highest in treatment having 100% RDF + FYM @6t/ha + *Azotobacter* + PSB (T<sub>11</sub>). In terms of economics, the highest gross return (Rs 41995.70) was found in 100% RDF + FYM @6t/ha + *Azotobacter* + PSB (T<sub>11</sub>), highest net return (Rs 12909.80) in 100% RDF + FYM @4t/ha + *Azotobacter* + PSB (T<sub>10</sub>) but the highest B:C ratio (1.53) was recorded with the treatment T<sub>2</sub> (75% RDF).

## **Effects of Manganese on some rice genotypes in acid soil of Assam**

*Alankrita Dutta*

Wheat (*Triticum aestivum* L.) is a major contributor of country's food bowl; it is the staple crop of the world and second most important crop in India. Water stress is the most significant environmental stress in agriculture worldwide and improving yield under drought has become a major goal among scientists. All phases of plant growth are not equally vulnerable to water deficit. So, a laboratory experiment and a pot culture were accomplished in the Crop Physiology department of AAU, Jorhat (November 2019-March 2020), to study the effects of coconut milk (CM) and kinetin on wheat (Var-SKU-1) during physiological drought condition. The experiment consisted of 7 treatments viz. T0: Control, T1: 10%coconut milk, T2: 30%coconut milk, T3: 50%coconut milk, T4: 10ppm Kinetin, T5: 30ppm Kinetin, T6: 50ppm Kinetin, laid in CDR design with 3 replications. In the laboratory experiment, 30%CM showed the best results in germination (87%), and seed vigour index (771.2). During the pot experiment, 10ppm Kinetin showed the best results comprising of the parameters viz., leaf area at ear emergence stage (16.580 cm<sup>2</sup> /plant), tiller number per plant(8.067), effective tillers per plant (3.565), RLWC in maximum tillering stage(48.070 %), RLWC at ear emergence stage (59.857 %), SLW at maximum tillering stage(3.01 gcm<sup>-1</sup>), SLW ear emergence stage(2.909g/cm), plant height at harvest(85.857 cm), root dry weight at harvest(19.13g/plant), shoot dry weight at harvest(19.33g/plant), total chlorophyll content at maximum tillering stage(1.377 mg g<sup>-1</sup> fw of leaf), total chlorophyll content ear emergence stage(3.477 mg g<sup>-1</sup> fw of leaf), total carbohydrate content in grains at harvest(118.11 mg g<sup>-1</sup> dw), total nitrogen content in grains(118.11 mg g<sup>-1</sup> dw), nitrate reductase (NR) activity at maximum tillering stage(20.19 nmol NO<sub>2</sub> g<sup>-1</sup> fw of leaf hr<sup>-1</sup>), nitrate reductase (NR) activity ear emergence stage(21.97 nmol NO<sub>2</sub> g<sup>-1</sup> fw of leaf hr<sup>-1</sup>), proline content at ear emergence stage (30.19mg g<sup>-1</sup> fr.wt), no of seeds per spike at harvest(31.177), length of spike(10.27cm), spike weight (1.922 g), test weight(27.967g), economic yield (0.999g/plant), biological yield(12.32g/plant), harvest Index(8.807%). 30% CM showed best results in case of leaf area at maximum tillering stage (14.154 cm<sup>2</sup>/plant) and proline content at maximum tillering stage (30.05 mg g<sup>-1</sup> fr.wt). Moreover, 10ppm Kinetin (23) and 30% CM (4) exhibited the highest response scores among the treatments in the pot experiment.

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## **Effect of different storage conditions on grain quality of paddy (*Oryza sativa* L.)**

*Angshuman Sarmah*

Storage plays a crucial role in the post-harvest management of crops by ensuring the incessant supply of grains or stored products throughout the year. During storage, many physiological and physiochemical changes take place, which all affect the quality of the stored paddy grain. The study was conducted to investigate the changes in the physicochemical properties of paddy grains (var. Ranjit) stored in hermetic and traditional storage conditions, and to identify the best storage condition, under study, with high potentiality of storage under climacteric condition of Assam. In order to achieve the goal of the study, seven different storage structures were selected. They were gunny bags (T1), elevated pacca bin (T2), elevate kaccha bin(T3), plastic bags (T4), IRRI super bags (T5), sun drying or open storage (T6) and solar in-store drier (IRRI prototype) (T7). Paddy grains were cleaned and sundried to a moisture level of 13% and then stored on the cited seven experimental receptacles at RARS, Titabar. The changes of some quality components such as germination percentage, seed vigour index, seed moisture content, head rice recovery, soluble protein content, starch content, total soluble sugar, reducing sugar, non-reducing sugar, amylose content, stored grain mycoflora, and insect infestation were monitored at bimonthly interval over twelve months of storage. Based on the results of study it was found that physiological parameters like germination percentage, seed vigour index, and head rice recovery of rice dropped with advancement in the storage period. The other biochemical parameters like soluble protein content, starch content, non-reducing sugar and amylose content were found declining whereas, total soluble sugar, reducing sugar and amylopectin content of the stored paddy increased significantly as the storage duration proceeded, irrespective of storage structures. Seed moisture content, found as most crucial factor, escalated till July (reached maximum value of 15%) and again declined with the season and time. However, the rate of change of the parameters in each structure was different. The easily moisture permeable structures (T2, T3, T6) showed the maximum change in the parameters followed by permeable (T1 and T4) and impermeable (T5 and T7). The rate of change in the values of parameters in paddy stored in solar in-store drier was found slowest and sluggish, and maintained highest mean values amongst all the storage

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receptacles in respect of germination percentage, seed vigour index, head rice recovery, moisture content, total soluble protein content, starch content, total soluble sugar content, reducing sugar, non-reducing sugar, amylose and amylopectin content as 91.31%, 1143.89, 78.17, 13%, %, 12.86%, 71.71%, 1.27%, 0.283%, 0.989%, 23.62% and 78.38% respectively, and sun drying or open storage condition (T6) showed the maximum deviation from the initial values. The seed borne pathogens were associated along with the seed. Storage fungi were increased gradually whether field fungi were seen to be disappeared after few months of storage. The observed fungi genera were *Alternaria* spp., *Fusarium* spp., *Curvularia* spp., *Aspergillus* spp., *Penicillium* spp., *Rhizopus* spp. and *Bipolaris* spp. Amongst mycoflora, *Aspergillus* spp. and amongst stored grain insect *Sitotroga cerealella* was abundant in the storage receptacles under prevailing weather conditions of Assam. Insect attack was severe in easily permeable structures. With increase in the fungal contamination and insect invasion the quality parameters of stored paddy found to decrease, along with time. Significant superiority of hermetic storages over traditional storage structures of Assam irrespective of all the parameters studied was noticed. Hermetic storage was effective at blocking the effects of external humidity fluctuations as well as the spread of fungi and insects. The solar in-store drier was found to be best amongst all storage structures, in all quality aspects of the long-term storage of paddy.

## **Physio-chemical responses of broccoli (*Brassica oleracea* var. *italica*) to different fertigation treatments**

*Boishali Handique*

A field experiment was conducted at ICR Farm, Assam Agricultural University, Jorhat during winter season of 2019-20 to study the “Physiochemical responses of broccoli (*Brassica oleracea* var. *italica*) to different fertigation treatments”. The experiment consisted of four irrigation levels viz., I1: 1.20 Etc (drip at 120% Etc), I2 : 1.00Etc (drip at 100% Etc), I3: 0.8 Etc (drip at 80% Etc) and I4: 0.6Etc(drip at 60% Etc) and four fertilizer levels viz. F1: 100% recommended dose of N P and K (RD) through drip, F2: 75% RD through drip, F3: 50% RD through drip and F4 : No fertilizer. The experiment was laid out in 4x4 Factorial RBD with 3 replications. The Green Magic (F-1hybrid) variety was sown on 20th Nov., 2019, transplanted from 20<sup>th</sup> -22nd Dec., 2019 and harvested between 21th -24th March, 2020. During the study the highest plant height (38.90 cm), leaf number per plant (18), leaf length (30.47 cm), leaf breadth (22.83 cm), plant spread (53.40 cm), leaf area per plant (3042.96 cm<sup>2</sup>), LAI (3.70) and LAD (50.90 days) were found in treatment combination of I1F1. While, they were lowest in I4F4 with plant height (10.87 cm), leaf number per plant (6), leaf length (9.40 cm), leaf breadth (9.05 cm), plant spread (17.90 cm), leaf area per plant (891.62 cm<sup>2</sup>), LAI (0.71), LAD (14.77 days) and RLWC (85.07%). The physio-chemical characters like chlorophyll content of leaf (0.52 mg/g fw), chlorophyll stability index (86.39%), root volume (658.90 cc), root biomass (29.86 gm), rate of photosynthesis (65.51 μmol/m<sup>2</sup>/s), rate of transpiration (25.03 μg/cm<sup>2</sup>/s) and protein content (35.67 mg/g fw) were highest under I1F1, while lowest were found in I4F4 (0.22 mg/g, 26.23%, 18.19 μmol/m<sup>2</sup> /s, 5.10 μg/cm<sup>2</sup>/s, 59.43% and 12.43mg/g respectively). In contrast, lowest ascorbic acid (53.13 mg/100g) was found in I1F1 and highest (119.63 mg/100g) in I4F4. The maximum head yield (290g/plant & 21.50 t/ha), harvest index (53.40%), N,P,K in soil & leaf and water use efficiency (49.40 kg/ha/mm) were recorded in I1F1. The lowest yield (54g/plant & 4.23 t/ha), harvest index (30.24 %), N, P, K in soil & leaf and water use efficiency (22.96 kg/ha/mm) were found in I4F4. Thus, I1F1 was found to be the best treatment combination for broccoli while I4F4 produced the poorest performance during the investigation.

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## **Effect of Preharvest Application of Plant Growth Regulators on Morpho-Physiology, Yield and Vase Life of Gerbera (*Gerbera jamesonii*)**

*Kuldeep Boruah*

An experiment entitled “Effect of preharvest application of plant growth regulators on morpho-physiology, yield and vase life of gerbera (*Gerbera jamesonii*)” was conducted during November, 2021 to March, 2022 in Alengmora village, Jorhat, Assam to evaluate the effect of preharvest application of plant growth regulators on morpho-physiology, yield and vase life of gerbera. Two year old gerbera plants were rejuvenated in greenhouse condition and the experiment was conducted in two phases i.e. (A) greenhouse experiment and (B) laboratory experiment. For the greenhouse experiment, three plant growth regulators at different concentrations viz. brassinosteroid (0.5, 1.0, 1.5 ppm), benzyl adenine (50, 100, 150 ppm) and salicylic acid (50, 100, 150 ppm) were selected. In this phase of experiment, rejuvenated gerbera plants were treated twice by different concentrations of PGRs as foliar application. First application was done at 14 days after rejuvenation and the second one at 14 days after the first spray. It was observed that relative leaf water content and shoot fresh weights of the tested plants were enhanced by all the PGR treatments. Among the treatments, 100 ppm BA was found superior in respect of foliage height, leaf number, leaf area, shoot fresh weight, shoot dry weight, chlorophyll content, relative leaf water content, flower diameter, stalk length, stalk diameter and flower yield. However, the highest root volume, root fresh and dry weights were recorded in plants treated with 1.0 ppm BR. Recorded data revealed that 100 ppm BA exhibited pronounced promising results in enhancing growth and yield of gerbera compared to othistreatments. Flowers obtained from treated plants were selected to evaluate the effect of preharvest application of PGRs on vase quality of gerbera. Results obtained from this phase of experiment indicated that different post-harvest characters such as highest moisture content, fresh and dry weights of flowers, water uptake, transpirational water loss, vase life and lowest scape bending were observed with 100 ppm BA. 50 ppm BA and 1.5 ppm BR also exhibited enhanced vase life. Yield and vase life of gerbera flowers were enhanced by 39.89% and 16.23% respectively over control plants by BA 100 ppm treatment. It can be concluded that 100 ppm BA applied as preharvest treatment exhibited the most promotive results in respect to growth, yield and vase life of gerbera.

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**Major Adviser: Dr. Kaushik Das**

## **Physiological performance of sweet sorghum (*Sorghum bicolor* L. Moench) genotypes under Assam situation**

*Kundal Hazarika*

Sweet sorghum (*Sorghum bicolor* L. Moench) is a self-pollinated, diploid ( $2n=20$ ), C4 grass species belonging to the family poaceae. It is a drought tolerant crop, used as food for humans and feed for animals. In the present days, the crop has been given more importance due to its capacity to produce bio-ethanol or bio fuels. As in Assam, its cultivation is very limited, therefore, a field experiment was conducted at ICR farm of Assam Agricultural University, Jorhat during rabi season of 2019 with twelve diverse genotypes of sweet sorghum to evaluate the genotypes for various morpho-physiological traits and to find out the morpho-physiological basis for higher productivity. The experiment was laid out in randomized block design with three replications and the crop was raised following the recommended package of practices. The morpho-physiological parameters of the crop were recorded at various stages of plant growth following standard methodologies. The yield attributes and yield were recorded after harvest. The results indicated significant differences of all the morpho-physiological, phenological parameters, yield attributes and yield among different sweet sorghum genotypes. All the morpho-physiological parameters, yield attributes and yield were found significantly higher in the genotype ICSV 15006 followed by ICSV 25274, while, significantly lower values of all the above were recorded in ICSV 13012. Among the genotypes, ICSV-15006 possessed significantly higher plant height (165.87 cm), number of tillers (4.23), total dry matter (29.09 g) and total sugars in both stalks (14.58 %) and grains (11.94%) at harvest. The number of green leaves (26.73), leaf area index (3.78), RLWC (84.39%) and total leaf chlorophyll (2.98 mg g<sup>-1</sup> fresh weight) were also found significantly higher in the genotype ICSV 15006 followed by ICSV 25274. The genotype ICSV 15006 possessed more values of AGR and CGR at various growth stages. The same genotype also recorded the highest number of stomata and stomatal index percentage in both abaxial and adaxial leaf surface at 50% flowering stage. Interestingly, both the high yielding genotypes, ICSV 15006 and ICSV 25274 matured earlier as compared to other genotypes. Significantly higher values of various yield

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attributes and grain yield with 1.06 t ha<sup>-1</sup> was observed in the genotype ICSV 15006 followed by ICSV 25274 with 1.03 t ha<sup>-1</sup> . On the other hand, the lowest grain yield (0.56 t ha<sup>-1</sup>) was recorded in the genotype ICSV 13012. On the basis of morpho-physiological characters, yield attributes and yield, the genotypes ICSV-15006 and ICSV-25274 were identified as the superior genotypes which can be used in the further breeding programme for yield improvement in sweet sorghum.



## **Effects of Cytokinin and Calcium on Physiological Performance of Rice (*Oryza sativa* L.) Crop under Higher Manganese Condition**

*Nibedita Basumatary*

Rice (*Oryza sativa* L.) is one of the major cereal food crops for most of the people around the world. In rice, productivity is affected by either deficiency or toxicity of nutrients. In North-east India (21Mha) including Assam (4.7 Mha), available [Mn] is 3-52 ppm, its critical limit in soil is 2-3ppm, whereas in plants it is 15-20 ppm g<sup>-1</sup> dry weight, in excess of which, Mn becomes toxic to crop plants (Basumatary et al., 2014). So, a pot experiment following 'CRD' with two factors i.e. variety and treatment was conducted (January -July, 2022) to investigate into the effects of Cytokinin and Calcium on physiological performance of four rice genotypes (Kanaklata, Bishnuprasad, Jyotiprasad, Numoli) cultivated under higher Mn condition (Mncon: [Mn]: initial 30ppm at soil pH 4.89+added 20ppm, soil pH 5.1]. The experiment consisted of five treatments (replicated thrice): T1 (20 ppm Mn (MnSO<sub>4</sub>.3H<sub>2</sub>O) as basal at vegetative stage), T2 (20 ppm Mn as basal at vegetative stage + 100 ppm cytokinin (kinetin) root-dip treatment (RDT) before transplanting, T3 (20 ppm Mn as basal at vegetative stage + Coconut milk (zeatin): 10X dilution for RDT before transplanting, T4 (20 ppm Mn as basal at vegetative stage + 500 ppm CaCl<sub>2</sub> RDT before transplanting, T5: Control: T5= Natural soil without addition of 20ppm MnSO<sub>4</sub>.3H<sub>2</sub>O as basal+ without Cytokinin & without CaCl<sub>2</sub> RDT before transplanting. In the study, in general, among the treatments, 20 ppm Mn as basal at vegetative stage plus 100 ppm Cytokinin (kinetin) RDT before transplanting produced the maximum values of most of the morphological, physiological, biochemical and yield parameters of the crop. However, almost all the parameters were reduced in plants in presence of higher [Mn:30ppm] or natural condition. In the study, soil treated with 20 ppm (Total [Mn] =30ppm initial plus 20ppm Mn added) significantly decreased in Specific Leaf weight: SLW (8.52%), plant height (7.04%), shoot biomass (9.2%), number of tillers (10.9%), number of effective tillers (5.55%), number of leaves (6.68%), root biomass (11.07%), total chlorophyll content (14.52%), NR activity (17.77%), carbohydrate content (3.83%), panicle length

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(16.16%), panicle weight (1.56%), panicle number per plant (6.31%), number of seeds per panicle (12.77%), test weight (1.65%), HD grains (7.33%), sterility percent (8.63%), economic yield (10.27%), biological yield (13.61%), and Grain Harvest index (1.42%). In Contrast, soil treated with 20 ppm Mn as basal at vegetative stage along with various plant growth regulators like Cytokinin, Coconut milk and Calcium 7 chloride, resulted increases in SLW (2.19-7.66%), plant height (5.09-13.2 %), shoot biomass (3.02-7.01%), number of tillers (8.93-27.49%), number of effective tillers (19.35-40%), number of leaves per plant (7.65-27.37%), root biomass (8.87-21.94%), carbohydrate content (2.24-10.92%), panicle length (8.64-19.05), panicle weight (5.58- 11.80%), panicle number per plant (2.55-8.97%), number of seeds per panicle (3.34- 9.51%), test weight (8.70-17.28%), HD grains (2.64-3.51%), economic yield (4.70- 13.38%), biological yield (3.36-10.53%), grain harvest index (1.67-3.30%), total chlorophyll (4.13-6.35%), NR activity (4.46-10.08%). Among the various genotypes, Kanaklata was found to be best one in respect of morpho-physiological (SLW: 4.76 mg cm<sup>-2</sup> , plant height: 83.369 cm, shoot biomass: 27.69 g plant<sup>-1</sup> , No. of tillers: 8.53, no. of effective tillers: 6.4); biochemical (total Chl: 1.861 mg g<sup>-1</sup> f.w., Chl „a“ (0.924 mg g<sup>-1</sup> f.w), Chl „b“ (0.933 mg g<sup>-1</sup> f.w), Carbohydrate: 9.202 mg g<sup>-1</sup> , [Ca<sup>2+</sup>] in roots (59.35 ppm); and yield attributing parameters (panicle length: 25.01 cm, panicle weight: 6.24 g, panicle number per plant: 7.15, number of seeds per panicle: 74.68), economic yield: 13.39), biological yield: 42.54, and Harvest index: 47.79). The study also proved actions of Cytokinin (i.e. enhancement of root biomass) and Calcium (probably, the membrane stability) are the features of the tolerance of crops under higher [Mn] acid soil situation. The correlation studies revealed that seed yield was positively correlated with panicle length (0.994\*\*), panicle weight (0.90\*), panicle number per plant (0.997\*\*), seed per panicle (0.982\*\*), test weight (0.944\*), HD grains (0.907\*). The study therefore, revealed that the application of 100 ppm Cytokinin (Kinetin) as root-dip treatment before transplanting may be practiced for increasing the growth, morphological, biochemical as well as yield and yield attributing parameters of rice crop under higher [Mn] containing acid soil situation elsewhere.

## **Evaluation of Some Chickpea (*Cicer arietinum* L.) Genotypes under Delayed Sowing Situation in Simulated Soil Moisture Condition**

*Priyanuj Baruah*

Chickpea (*Cicer arietinum* L.), often known as the chick pea, is an annual legume that belongs to the Fabaceae family and subfamily Faboideae. Its diverse varieties go by many names, including gram or Bengal gram, garbanzo bean, and Egyptian pea. It is grown on 10.57 million hectares of land in India, producing 11.16 million tonnes annually, with an average yield of 1056 kg/ha (Anon, 2018). Madhya Pradesh, Maharashtra, Uttar Pradesh and Rajasthan are the major chickpea production states in India. In Assam it is grown in an area of 2429 hectares, producing 1582 tonnes with an average productivity of 650kg/ha (Anon, 2017). It is grown mainly in rabi season. Air temperature and photoperiod have a major influence on the timing of reproductive events in chickpeas, with the rate of progress to flowering being a linear function of mean temperature. For growth and pod filling, chickpeas are well adapted to temperatures between 30 and 15 °C (day maximum and night minimum). In Assam, it can be seen that rice fallows offer good scope to use the area for chickpea cultivation in Assam. In Assam winter rice also locally known as Sali rice, is the most important one which occupies about 75 percent of total rice area, that covers an area of about 18-19 lakh hectares. After the harvest of Sali rice, about 9.9 lakh hectares of medium textured land remains fallow. Rabi crops occupy about 3.39 lakh hectare only. The remaining 6.51 lakh hectare is the potential area for cultivation of chickpea in rice fallows. As per package of practices the suitable sowing time range is between mid-Oct to mid-November. However, the rice growing areas of Assam which can be put under chickpea cultivation becomes vacated only during third week of November and land preparation also takes some time. Therefore, to utilize the rice fallow land for chickpea cultivation profitably, the genotype to be used should be having better adaptability to soil moisture depletion for initial establishment and vegetative growth. The genotypes should also be able to adapt to the rising temperature during reproductive stage as with delay in sowing the reproductive stage will coincide with a period which experiences rise in temperature. The progressive shortening of photoperiod with delay in sowing time is likely to affect

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both vegetative and reproductive growth. With these background a study was formulated and carried out with five genotypes of chickpea grown at three different dates of sowing and three different soil moisture regimes viz. soil moisture content at 90%,70% and 60% of field capacity under each sowing date using pot culture. The study was conducted in the rainout shelter phenotyping facility of Department of Crop Physiology, Assam Agricultural University during (Nov,2021- April 2022). The pot experiment was laid out in factorial completely randomized design with three replications. From the study, significant variations in different physiological and yield characters were observed in the chickpea plants as influenced by genotypes and soil moisture regimes at all the different dates of sowing. Generally, all the genotypes showed a decreasing trend in most of the physiological and yield traits except the lipid peroxidation, proline and superoxide dismutase activity which showed a rising trend. Within each date of sowing the performance of individual genotypes varied significantly. IPC 07-28 and IPC 11-112 showed higher values of the parameters viz. plant height, leaf area index, plant biomass, root surface area and volume, RLWC, no. of pods per plant, no. of seeds per pod, grain yield , harvest index as compared to other genotypes under all the three soil moisture regimes under three different dates of sowing. Percent reduction in these parameters with declining soil moisture level was also lowest in the genotype IPC 07-28 for the above mentioned traits. The genotype IPC 07-28 also recorded lowest lipid peroxidation and highest membrane stability index. When sowing was done on 25th November, the percent reduction in grain yield with IPC 07-28 at a soil moisture content of 60% of field capacity compared to 90% of field capacity was only 8%, whereas corresponding decrease in JG-14 was 14%. Again the percent reduction in grain yield with a soil moisture content of 60% of field capacity in genotype IPC 07-28 was only 10% and 13% respectively when sowing was done on 5th December and 15th December; the corresponding values in case of JG-14 was 21% and 26% indicating better adaptability of the genotype IPC 07-28 under delayed dates of sowing as well as under reduced soil moisture regime.

## **Nitrogen acquisition under elevated CO<sub>2</sub> and temperature in rice (*Oryza sativa* L.)**

*Pronamee Doulboruah*

A field experiment was conducted at stress physiology laboratory, AAU, Jorhat during kharif season of 2020-2021 to study the “Nitrogen acquisition under elevated CO<sub>2</sub> and temperature in rice (*Oryza sativa* L.). The experiment was carried out in controlled environment under CO<sub>2</sub> temperature gradient tunnel (CTGT), to understand the differential response of rice to higher level of CO<sub>2</sub> i.e. CTGT-I at ambient CO<sub>2</sub> 395 ppm & temperature, CTGT-II at elevated CO<sub>2</sub> (550±20ppm) + temp. of 4 0 C > ambient and CTGT-III at elevated CO<sub>2</sub> (750±20ppm) + temp. of 6 0 C > ambient with four different level of N treatment viz. N0 (zero N), N1 (75% recommended dose), N2 (100% of recommended dose), N3 (125%of recommended dose). The experiment was laid out in two factorial completely randomized block design (FCRD) with 10 replications. The popular rice cultivar of Assam, Luit, was collected from research station of Agricultural University. This experiment was conducted on pot which was sown on 8th Aug 2020 and harvested between 28th Nov to 2nd Dec 2020. In the experiment under elevated CO<sub>2</sub> and temperature there was a significance difference of crop growth parameters where highest value were recorded at CTGT-II with N3. In phenological data highest value was recorded at CTGT-III with N3. All biochemical and anatomical parameters also exhibit better result in CTGT-II with N3 as compared to CTGT-I. Membrane related phenomenon i.e. MSI was recorded as high at CTGT-II with N3. But there was a negative trend in H<sub>2</sub>O<sub>2</sub> and lipid peroxidation where highest value was recorded at CTGTIII with N0. Similar result also found in water relation parameters and all physiological parameters. Chlorophyll florescence related phenomenon shows highest result in CTGT-II at N3. Likewise, yield attributing parameters gave highest value in CTGT-II with N3. Results shows that application of N significantly increased various morphological growth parameters as well as yield parameters in rice under elevated CO<sub>2</sub> condition (at 550±20 ppm with 40 c temperature) under CTGT-II as compared to CTGT-I and CTGT-III. High temperature has a deleterious effect on plant growth and some related processes viz. physiological and biochemical activities because an effect on C: N ratio. Therefore, supplementation of N may play a pivotal role in amelioration of some deteriorative process like lipid peroxidation content and MDA

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content of leaves thereby reduced yield by affecting yield attributing parameters. Results indicated that higher doses of N under elevated CO<sub>2</sub> and temperature invariably maintained not only the C:N ratio but also improved the physiological response positively. But at lower level of N in plant showed poor plant growth as well as metabolic de-arrangement because of low photo synthetic rate, nitrate reductase activity, chlorophyll loss and depression membrane stability index. Therefore, modification of agriculture and nutrient management technologies for future environments is important criteria for sustainable management of rice ecosystem.

## **Physiological Basis of Drought Tolerance in Foxtail millet**

*Ramesh R*

The experiment was carried out to screen drought tolerant genotypes and to study the physiological, biochemical and yield response of Foxtail millet genotypes. The investigation was carried out in the Stress Physiology Laboratory, Department of Crop Physiology, Assam Agricultural University, Jorhat, during May 2020 to April 2021. In the first experiment 33 genotypes were screened for drought tolerance under varied level of PEG-6000 (0 MPa, -0.25 MPa, -0.50 MPa). Among the 33 genotypes used in the study ISe1664, ISe1647, ISe1745, ISe1882, ISe1888, ATL-1, and CO-7 were selected as relatively tolerant to drought using the various germination and seedling indices and cluster analysis. The selected genotypes were further studied for the physiological response under the rain out shelter till the harvest. Morphological investigation showed that plant height, number of leaves, leaf area and LAI were reduced significantly irrespective of the genotypes by the influence of drought. It might be a strategy of conserving water loss by transpiration. Biomass accumulation also found to be retarded under drought stress. However, the root shoot ratio found to be higher compared to well-watered condition. It shows the partition of photosynthates towards below ground parts to extract the water efficiently. RWC and MSI were found to be reduced however, genotype ATL-1 and ISe1664 can able to maintain the water content and membrane integrity. Photosynthetic pigments were reduced under drought due to drought induced degradation of pigments. Photosynthesis associated parameters were reduced under drought, stomatal limitation supposed to had role in reduction of CO<sub>2</sub> assimilation. Chlorophyll fluorescence showed that maximum yield and efficiency of PSII was reduced highly among the susceptible genotypes mean while NPQ were increased to dissipate the excess captured energy and to reduce ROS generation. Yield attributing traits like number of tillers, panicle weight, panicle length and test weight were reduced. Among the seven selected genotypes ATL-1 and ISe1664 showed better performance in terms of physiologically and agronomically. Which is reflected in the DSI where these genotypes were relatively tolerant than ISe1745.

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## **Effect of seed biopriming with indigenous fungal isolates on growth and yield of okra (*Abelmoschus esculentus* L.)**

*Rijuleena Bhuyan*

A series of experiments were conducted during the year 2021 in the Department of Crop Physiology, AAU, Jorhat to evaluate the effect of seed biopriming by indigenous fungal isolates on germination, growth and yield of okra. Three different fungal strains viz., *Trichoderma harzianum*, *Metarhizium anisopliae* and *Verticillium lecanii*, isolated and prepared from indigenous sources were selected for the research programme. In the first experiment, which was conducted under laboratory condition, okra seeds were bioprimed with these fungal isolates with four different concentrations (0.30%, 0.50%, 0.70% and 0.90%) separately. Additional two separate sets, one with hydroprimed seeds and another with unprimed control, were also kept for comparison. Seed germination and early seedling growth of the tested crop in terms of germination percentage, germination index, root and shoot lengths, fresh and dry weights and vigour index of the seedlings were found to be increased by all the priming treatments. Among the different treatments, 0.50% *T. harzianum*, 0.70% *M. anisopliae* and 0.70% *V. lecanii* exhibited better promotive results compared to the other treatments. The second experiment, which was also a laboratory trial, was carried out to evaluate the combined effects of the different indigenous fungal biopriming agents. Among the different treatment combinations, *T. harzianum* (0.50%) + *M. anisopliae* (0.70%) showed the most promotive results in respect to germination and early seedling growth of okra. Third experiment was conducted in pots under shed-house to evaluate the combined effect of *T. harzianum*, *M. anisopliae* and *V. lecanii* as biopriming agents on morphophysiology, growth and yield of okra. For comparison other two sets were also kept, one with hydropriming treatment, and one as unprimed control. All the recorded growth and morphophysiological parameters such as plant height, leaf number, leaf area, root volume, shoot and root dry weights were increased by all the treatments. Plant water relation of the crop in terms of relative leaf water content (RLWC) was found to be positively affected by the applied seed priming treatments. Leaf chlorophyll content of the tested crop was also increased by the seed priming treatments. However, no such

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effect was observed on the leaf proline content of the crop. Yield and all the recorded yield attributing characters such as days to first flower initiation, fresh and dry weights of pod, fresh and dry weights of the seeds were positively affected by the applied treatments. All the fungal biopriming agents exhibited better results compared to the hydropriming treatment. Among the different biopriming treatments, *T. harzianum* (0.50%) + *M. anisopliae* (0.70%) showed the most promotive results in respect to growth and yield enhancement in okra.

## Physiological Responses of Linseed (*Linum usitatissimum* L.) to Different Organic Weed Management Practices

Siddika Naznim

An experiment entitled “Physiological responses of linseed (*Linum usitatissimum* L.) to different organic weed management practices” was conducted at ICR Farm, Assam Agricultural University, Jorhat during Nov-March, 2021-22. The experiment consisted of nine organic weed management practices i.e. T<sub>1</sub>: 1 hand weeding, T<sub>2</sub>: 1 mechanical weeding + 1 hand weeding, T<sub>3</sub>: Intercropping with pea (2:1) + 1 hand weeding, T<sub>4</sub>: Stale seedbed + reduced spacing (25%) + mulching with rice residues + 1 hand weeding, T<sub>5</sub>: Locally available dry weed mulch (3 inch thick) + 1 hand weeding, T<sub>6</sub>: Application of Mustard oil cake (5t/ha) + 1 hand weeding, T<sub>7</sub>: Deep ploughing during summer + 1 hand weeding, T<sub>8</sub>: Weed free and T<sub>9</sub>: Weedy (Control). The experiment was laid out in RBD with 3 replications. The highest plant height (57.67 cm), primary branch number plant-1 (6.13), leaf number plant-1 (218.00), single leaf area (4.48 cm<sup>2</sup>), leaf area plant-1 (976.64 cm<sup>2</sup>), SLW (0.0606 gcm<sup>-2</sup>), leaf chlorophyll content (3.04 mg g<sup>-1</sup> fw), chlorophyll stability index (51.25), RLWC (68.87%), NR activity (6.39 µg NO<sub>2</sub> g<sup>-1</sup> h<sup>-1</sup>), RGR (9.67 mg mg<sup>-1</sup> day<sup>-1</sup>), NAR (0.0028 mg cm<sup>-2</sup> day<sup>-1</sup>), seed yield plant-1 (4.25g), 1000 seed weight (9.91g) harvest index (34.62%), oil content of seed (44.51%), TSS content of seed (2.95oBrix) and best soil quality parameters were found in treatment T<sub>6</sub>. In contrast, the lowest plant height (51.32 cm), primary branch number plant-1 (5.23), leaf number plant-1 (209.71), single leaf area (3.75 cm<sup>2</sup>), leaf area plant<sup>-1</sup> (786.41 cm<sup>2</sup>), LAI (2.62), LAD (76.35 days), SLW (0.0506 gcm<sup>-2</sup>), chlorophyll content of leaf (2.87 mg g<sup>-1</sup> fw), chlorophyll stability index (48.07), RLWC (65.70%), NR activity (5.85 µg NO<sub>2</sub> g<sup>-1</sup> h<sup>-1</sup>), RGR (6.00 mg mg<sup>-1</sup> day<sup>-1</sup>), CGR (7.38 g m<sup>-2</sup> day<sup>-1</sup>), NAR (0.0007 mg cm<sup>-2</sup> day<sup>-1</sup>), seed yield m<sup>-2</sup> (128.99 gm<sup>-2</sup>), seed yield ha<sup>-1</sup> (1.29 tha<sup>-1</sup>), harvest index (33.79%), oil content of seed (36.79%), TSS content of seed (2.60oBrix) and poor soil quality parameters were found in T<sub>9</sub>. Five different types of weed species were observed in the study plots of which highest 32.67% was *Cynodon dactylon*. Again significantly highest weed population was seen in T<sub>9</sub> (17.43 No. m<sup>-2</sup>) and lowest in T<sub>8</sub> (5.74 No. m<sup>-2</sup>) and at 75 DAS. The study

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therefore, revealed that additional application of MOC @5t/ha with one hand weeding could be suggested for the linseed grower of Assam which not only increase the yield and seed quality but also improve the soil health for subsequent crops

# **Physiological Responses of Locally Grown Foxtail Millet Genotypes [*Setaria italica* (L.)] of North East Region to the Simulated High Temperature Regimes**

*Venkateshwaran R*

An experiment was conducted to screen out the tolerant foxtail millet genotypes (*Setaria italica* [L.]) of N.E. Region of India. The genotypes were grown under the simulated high temperature regimes to study the various morpho-physiological, anatomical, biochemical, characteristic and their tolerance efficiency along with yield potential. The study was carried out in the Stress Physiology Laboratory at the Department of Crop Physiology, Assam Agricultural University, Jorhat-13 during the period from March to June, 2022. In the first experiment, a total of 20 foxtail millet genotypes were collected from N.E. regions viz, Assam and Nagaland. Other genotypes from IIMR, Hyderabad and Tamil Nadu were also collected for comparative study with the local genotypes. All the genotypes were screened for high temperature tolerance using the temperature-regulated seed germinators with varying temperature regimes viz., T1-28oC/20oC (day/night) (ambient), T2- 36oC/24oC (day/night) and T3- 42oC/30oC (day/night). Amongst the local genotypes, Tanji tanji, Ashipii wuhnu, China mujih showed tolerance ability under cluster analysis. These genotypes recorded high germination percentage and seed vigor index. In the second experiment, the selected genotypes were assessed for the plant response under high temperature stress using the bioreactors (15 DAS) from vegetative stage to harvest. It has revealed that a significant reduction in various morpho-physiological parameters viz., plant height, LAI, number of leaves, NDVI, LAD, SLW, shoot biomass and root parameters occurred with an increase in temperature irrespective of the genotype. Genotypes like SEA-51 and Ashipii wuhnu recorded highest susceptibility to high temperature stress whereas lowest was recorded in SEA-37, Tanji tanji and China mujih. The present study revealed a higher tolerance ability due to accumulation of proline, total soluble sugars, decrease in leaf area, stomatal conductance, leaf temperature and maintenance of RLWC and MSI value. Furthermore, decreased MDA levels in tolerant genotypes may positively impact on cell integrity, as demonstrated by a higher MSI value. The genotype with a higher

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amount of biomass production viz. SEA-37, Tanji tanji and China mujih exhibited higher tolerance to high temperatures due to higher biomass as a result of greater photosynthetic rate, sugar production. Various stress indicating parameters viz. PHSI, RLSI, DMSI, and YSI was significantly increased under high temperature stress T3[42oC /30oC (day/night)] followed by T2 [36oC /24oC (day/night)] as compared to ambient in both the tolerant and susceptible genotypes. Tolerant genotypes showed higher NR activity and SPAD value, under high temperature stress condition along with maintenance of yield. Yield and yield attributing characters such as the number of tillers/plants, panicles /plant, length of the panicle, number of grains per panicle, test weight, and grain yield, were significantly reduced under high temperature regimes. Our results revealed that tolerant genotypes viz. Tanji tanji and China mujih showed greater yield and yield attributing characters due to some amelioration effect.

## **Evaluation of Plant Oils against Papaya Mealybug, *Paracoccus marginatus* Williams and Granara de Willink**

*Bondita Bora*

The present study was carried out to evaluate the efficacy of three plant oils viz., neem seed oil; pongamia seed oil and jatropha seed oil against crawler and adult stages of papaya mealybug, *Paracoccus marginatus* by taking profenofos 50 EC as standard check during 2020-2022 in Post Graduate Laboratory, Department of Entomology, AAU, Jorhat. Experimental findings revealed that among the three plant oils evaluated, neem seed oil was found to be most effective against both the crawler and adult stages of papaya mealybug. In crawler stage the highest per cent mortality of 54.00, 65.00, 76.00 and 85.00 were recorded at concentration of 2.50% neem seed oil after 12, 24, 48 and 72 hours of treatment, respectively which was followed by pongamia seed oil with per cent mortality of 53.00, 63.00, 67.00 and 76.00 at 3.00 per cent concentration while jatropha seed oil registered the lowest per cent mortality of 45.00, 51.00, 69.00 and 73.00 at 4.00 per cent concentration after 12, 24, 48 and 72 hours of treatment, respectively. It was observed that the standard check i.e. profenofos 50 EC caused the highest mortality of 74.00, 85.00, 90.00 and 97.00% at 0.07 per cent concentration after 12, 24, 48 and 72 hours of treatment, respectively. The order of toxicity to *P. marginatus* (crawlers) with respect to LC50 values at 72 hours after insecticidal treatment was profenofos 50 EC (0.002%) > neem seed oil (0.828%) > pongamia seed oil (1.512%) > jatropha seed oil (3.086 %). Similarly, in adult stage the highest mortality of 60.00, 71.00, 82.00 and 85.00 per cent was recorded at 3.00 per cent concentration of neem seed oil after 12, 24, 48 and 72 hours of treatment, respectively followed by pongamia seed oil recording 55.00, 67.00, 72.00 and 81.00 per cent mortality at 3.50 per cent concentration after 12, 24, 48 and 72 hours of treatment, respectively and jatropha seed oil at 4.50 per cent concentration registered the mortality of 51.00, 60.00, 71.00 and 82.00 per cent whereas, it was observed that the standard check i.e. profenofos 50 EC caused highest per cent mortality of 71.00, 74.00, 82.00 and 91.00 at 0.10 per cent concentration after 12, 24, 48 and 72 hours of treatment, respectively. The results also revealed that per cent mortality of mealy bug increased

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gradually with increase in concentration as well as exposure period. Similarly, The order of toxicity to *P. marginatus* (adult) with respect to LC50 values after 72 hours exposure period was profenofos (0.003%) > neem seed oil (1.365%) > pongamia seed oil (2.033%) > jatropa seed oil (3.262). Thus, order of relative toxicity for both the stages i.e. crawler and adults of *P. marginatus* was profenofos 50 EC > neem seed oil > pongamia seed oil > jatropa seed oil for the exposure period of 12, 24, 48 and 72 hours.

## **Crop loss assessment and evaluation of certain insecticides against major insect pests of different okra cultivars**

*Chada Anu Reddy*

The present investigation was carried out to assess the crop loss and evaluate certain insecticides against major insect pests of different okra cultivars. The experiment was conducted at Experimental Farm, Dept. of Horticulture, Assam Agricultural University, Jorhat, Assam during *kharif*, 2020 and *spring-summer*, 2021.

The avoidable crop loss was found 47.93 per cent by *Earias vittella* in okra variety Arka Anamika when compared with completely protected plot of emamectin benzoate 5%SG @ 15gm *a.i./ha* and unprotected plots. The abundance of insect pests and natural enemies were observed in variety Arka Anamika. A total of 12 insect pests and 9 natural enemies were found during *kharif*, 2020 and *spring-summer*, 2021 and among these 3 were highly abundant, 4 abundant and 5 less abundant pest species. All the natural enemies were abundant in both the seasons. The highest per cent relative abundance was found in aphid during *kharif* and *spring-summer* season with 42.99 per cent and 46.88 per cent respectively. Regarding the natural enemies, the relative abundance of *Coccinella transversalis* was highest 24.80per cent and 25.69per cent during *kharif* and *spring-summer* respectively. It was found that there was no significant difference among the selected varieties *viz.*, Arka Anamika, Pusa Sawani and S-51 in plant height and leaf area at all the three stages but significant difference was seen in trichome density in adaxial side of fruiting stage and harvesting stage. The population of insect pest and per cent fruit infestation was found to be increasing in control plots with time.

The highest reduction of aphid and whitefly population and the lowest per cent fruit infestation was observed in treatment V1T1 (chlorantraniliprole 18.5%SC @25gm *a.i./ha* + Arka Anamika) at 5DAT in both the seasons. In *kharif*, 2020, 2.66aphid/3leaves, 0.66whitefly/3leaves and 4.00per cent fruit infestation were observed while 2.00aphid/3leaves, 0.33whitefly/3 leaves and 3.66per cent fruit infestation were recorded during *spring-summer*, 2021. Similarly the lowest population reduction of aphid observed was 9.33aphid/3leaves during *kharif* and 7.33aphid/3leaves during *spring-summer*; lowest reduction of whitefly population was observed 4.00 whitefly/ 3

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leaves during *kharif* and 3.00 whitefly/3 leaves during *spring-summer*, the highest per cent fruit infestation 12.33 per cent in *kharif* and 10.33 per cent during *spring-summer*, were recorded in treatment V3T3 (lambda cyhalothrin 5%EC @ 15gm a.i./ha + S-51). The jassid population showed decreasing trend up to 10DAT in both the seasons. The treatment V1T1 showed lowest jassid population during *kharif* and *spring-summer* season (1.00 and 0.66 nos./3 leaves respectively) and highest jassid population was found in treatment V3T3 in both the seasons (6.00 and 4.00 nos./3 leaves respectively). The maximum average yield (58.70q/ha) and highest benefit-cost ratio (3.08 : 1) were found in treatment V1T1 (chlorantraniliprole 18.5%SC @ 25gm a.i./ha + Arka Anamika).

There was no significant difference in respect of yield, plant height and leaf area among the varieties except trichome density which was different in case of Arka Anamika. Whereas significant difference was recorded among the insecticidal treatments for the management of *E. vittella* and the insecticide chlorantraniliprole 18.5% SC @ 25gm a.i./ha was the most effective insecticide.

# **Biosynthesis and Evaluation of Ag-Nano Particle From *Polygonum hydropiper* against Storage Insect Pests**

*Chandana C R*

The investigation on biosynthesis and toxicity of Silver-Nanoparticles (AgNPs) using aqueous leaf extract of *Polygonum hydropiper* was carried out at Department of Entomology, Plant Pathology and Agricultural Engineering, AAU, Jorhat against *Callosobruchus chinensis* and *Sitophilus oryzae* during 2020-2022. Synthesis of AgNPs was confirmed by using various physiochemical methods viz., UV-Vis spectrophotometer (peaked at 420 nm), Dynamic Light Scattering (DLS) analysis [average size of nanoparticles was 46.65 nm with a Polydispersity index (PdI) of 0.600], Zeta potential (-9.32 mV), Transmission Electron Micrograph (TEM) (shape was spherical; size 2-50 nm) and Scanning Electron Micrograph (SEM) (shape-spherical without agglomeration). The bioefficacy test of biosynthesized AgNPs against *C. chinensis* and *S. oryzae* at different concentrations viz., 100 ppm, 150 ppm, 200 ppm, 250 ppm and 300 ppm and dosage viz., 0.5, 1.0, 2.5, 5.0 and 7.5 ml/kg seed along with a commercial neem formulation @ 4 ml/kg seeds/grains as standard check with respect to adult mortality (%), seed damage (%), and seed weight loss (%) recorded at different time interval revealed that the highest mortality (90.00% and 43.33%), lowest seed damage (0.13% and 0.07%), lowest seed weight loss (1.83% and 2.33%) and lowest LC50 value (0.392 ml/kg and 15.505 ml/kg) of *C. chinensis* and *S. oryzae*, respectively at 300 ppm concentration and a dosage of 7.5 ml/kg after 14 days of treatment. It was also evident that the green gram seeds infested by *C. chinensis* and treated with AgNPs showed highest germination (96.67%) and highest vigour (1434.67) at 200 ppm with a dosage of 0.50 ml/kg, along with the highest moisture content (8.93%) at 300 ppm concentration @ 7.5 ml/kg of seed. The paddy seeds infested by *S. oryzae* and treated with AgNPs showed the highest germination (97.33%) at 100 ppm concentration, the highest vigour (1483.20) at 250 ppm and the highest moisture content (8.93%) at 100 ppm concentration @ 0.5 ml/kg of seed. In our present investigation, we confirmed biosynthesized AgNPs from *Polygonum hydropiper* and their suitability in managing storage insect pests, including *C. chinensis* and *S. oryzae* ensuring the qualitative

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parameters of both green gram and rice seeds. Therefore, it could be concluded that the use of bio-synthesized AgNPs could be a promising strategy for storage insect pests management in years to come.

# **Interactions of cellular immunocytes in red pumpkin beetle, *Aulacophora foveicollis* (Coleoptera: Chrysomelidae) against entomopathogenic bacteria *Bacillus thuringiensis***

*Diplina Yein*

The study “Interactions of cellular immunocytes in red pumpkin beetle, *Aulacophora foveicollis* (Coleoptera: Chrysomelidae) against entomopathogenic bacteria *Bacillus thuringiensis*” was carried out in the Department of Entomology and in the Department of Plant Pathology, Assam Agricultural University, Jorhat during 2020-21. Study on biology of *Aulacophora foveicollis* revealed the length and breadth of the egg was  $0.67 \pm 0.06$  mm and  $0.57 \pm 0.06$  mm; while that of the 1st, 2nd, 3rd and 4th instar grub was  $2.03 \pm 0.26$  mm,  $4.59 \pm 0.56$  mm,  $7.71 \pm 0.18$  mm,  $11.20 \pm 0.86$  mm and  $0.39 \pm 0.02$  mm,  $0.66 \pm 0.11$  mm,  $0.84 \pm 0.11$  mm,  $3.03 \pm 0.24$  mm respectively; for the pupae it was  $5.17 \pm 0.34$  mm and  $3.06 \pm 0.21$  mm; for the adult male and female it was  $6.81 \pm 0.65$  mm,  $7.85 \pm 0.82$  mm and  $2.69 \pm 0.31$  mm,  $3.04 \pm 0.30$  mm respectively. The average development period of the eggs, 1st, 2nd, 3rd, 4th instar grub, pupae, adult male and adult female was  $11.4 \pm 2.63$ ,  $4.2 \pm 0.42$ ,  $4.3 \pm 0.48$ ,  $3.6 \pm 0.51$ ,  $4.9 \pm 0.73$ ,  $13.1 \pm 1.19$ ,  $42.0 \pm 1.5$  and  $45.0 \pm 1.71$  days respectively. In this study, the cellular immunocytes of red pumpkin beetle, *Aulacophora foveicollis* were studied and identified as prohaemocytes (PRs), plasmatocytes (PLs), granulocytes (GRs), coagulocytes (COs) and oenocytes (OEs). The total haemocyte count (THC) of the insect was found to range between 4100 – 5100 cells/mm<sup>3</sup> in healthy insects. The PRs were the smallest and the most abundant cells in the haemolymph with a DHC of 34.86 - 38.21% while the OEs were the largest and the least abundant cells with a DHC of 3.25- 5.36%. The physiological reaction of the immunocytes of red pumpkin beetle (*Aulacophora foveicollis*) in response to entomopathogenic bacteria *Bacillus thuringiensis* (Bt) was studied at different time intervals post treatment i.e. 0, 6, 12, 24, 36, 48, 72, 96, 120 hours after treatment (HAT). It showed that THC of Bt treated insects were significantly decreased from 6 HAT and the lowest decrease in THC was observed at 120 HAT. The DHC count after Bt treatment showed that the PR count showed significant reduction from 24 HAT onwards. The PL and GR count was

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significantly increased from 6 HAT which depicts that they were the primarily involved in the immune functions. The CO count showed significant increase at 24, 36, 48, 72 and 96 HAT while the OE count showed a significant increase only at 120 HAT. The haemocytes showed morphological alterations like vacuolization, cytoplasmic extensions, formation of pseudopods and degranulation on treatment with Bt. And also 6 the defence mechanisms, such as phagocytosis, encapsulation and nodulation were exhibited by *A. foveicollis* against *B. thuringiensis*. Despite the presence of defence responses the bacterial infection progressed and lead to death of the insect causing significant mortality from 7 DAT. Hence, it can be concluded that *Bacillus thuringiensis* can be considered as a potential component in the IPM against *Aulacophora foveicollis*.

## **Impact of certain newer insecticides on soil faunal diversity in French bean (*Phaseolus vulgaris* L.)**

*Gourismita Nath*

Laboratory and field experiments were carried out in the Department of Entomology; Department of Plant Pathology and Horticulture Experimental Farm of Assam Agricultural University, Jorhat during 2020-21 to study the impact of certain newer insecticides on soil faunal diversity in French bean. Six newer insecticides viz., clothianidin 50 WDG, fipronil 0.3 G, thiamethoxam 25 WG, imidacloprid 70 WG, chlorantraniliprole 0.4 GR and fipronil 40%+ imidacloprid 40% WG were selected for conducting the experiment. Sampling for soil macro and microarthropods as well as soil microbial population were done at pre-treatment, 15, 30, 45 60 and 75 days after treatment (DAT). The soil macroarthropods were sampled using pitfall traps whereas the microarthropods were extracted through Tullgren Funnel. Assessment of soil microbial population was done by following the standard pour plate method. Experimental results revealed the hymenopterans as the most dominant group (54.74%) among the different soil macroarthropods observed prior to the application of insecticides followed by Coleoptera (13.68%) and Araneae (11.57%). Among the soil microarthropods, the abundance of Collembola and Oribatida were recorded to be 64.72 and 35.28 per cent, respectively in the pre-treated plots. The number of soil macroarthropods was ranged between 89.00 to 95.33/plot prior to the application of insecticides which showed statistical parity with each other. At 15 DAT, the abundance of soil macroarthropods in all the treated plots were reduced significantly (47.33-52.67 numbers) compared to the untreated control (89.33 numbers). However, maximum number of soil macroarthropods/ plot was recorded in chlorantraniliprole 0.4 GR treated plots (52.67) followed by clothianidin 50 WDG (50.33) and thiamethoxam 25 WG (49.67) treated plots. Perusal of data in respect of 30, 45, 60 and 75 days after treatment also showed a significant decrease in the numbers of soil macroarthropods as compared to the control, however, a gradual increase in the total number of soil macroarthropods was observed in each treated plots from 30 DAT onwards. Soil microarthropods obtained in different plots prior to the application of insecticides was ranged between 458.33 to 555.56 numbers/sq. m. All the insecticidal treatments did not exhibit any significant ( $p=0.05$ ) impact on soil microarthropod population during the experimental period.

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## **Diversity of insect forager and effect of *Xylocopa fenestrata* pollination on sponge gourd (*Luffa cylindrica*)**

*Irani Saikia*

The present studies on “Diversity of insect forager and effect of *Xylocopa fenestrata* pollination on sponge gourd (*Luffa cylindrica*)” was carried out during the year 2020-21 with the objectives to enumerate the diversity of insect forager in sponge gourd (*L. cylindrica*) and to study the foraging behaviour and effect of *X. fenestrata* pollination on sponge gourd (*L. cylindrica*) in Horticulture Experimental Farm, Department of Horticulture, AAU, Jorhat. The results indicated that the insect forager complex of sponge gourd consists of 13 insect species which belong to the five insect orders such as Hymenoptera, Diptera, Lepidoptera, Hemiptera and Coleoptera. Among the insect pollinators Carpenter bee (*Xylocopa fenestrata* and *Xylocopa leucothorax*) was recorded to be maximum (23.66% and 8.50%) followed by *Apis cerana* (27.22%), *A. dorsata* (14.55%), *Musca domestica* (9.39%) and *A. mellifera* (7.50%). Besides these, other insect foragers found to visit as frequent visitors of sponge gourd flowers were *Vespa cincta* (3.04%), *Apis mellifera* (3.03%), and *Coccinella septempunctata* (2.36%). The foraging behaviour of *X. fenestrata* revealed that they began visiting sponge gourd blossoms early in the morning and stopped later in the evening. The highest frequency of floral visits was found to be  $7.33 \pm 0.58$  per minute between 1000-1200 hours while the lowest was  $4.33 \pm 1.15$  per minute between 1400-1700 hours. Likewise the pollen load per trip was determined to be  $29.20 \pm 1.41$  mg between 1000-1200 hours of the day with a minimum of  $17.50 \pm 0.85$  mg during 1400-1700 hours. Whereas, the maximum amount of time spent per flower was measured to be  $26.16 \pm 1.011$  seconds and minimum was  $15.32 \pm 1.129$  seconds. The maximum number of fruits per plant was obtained from XP3 (i.e. *Xylocopa* pollination @ five *X. fenestrata* nest on bamboo) treatment (19.03) followed by XP2 (i.e. *Xylocopa* pollination @ three *X. fenestrata* nest on bamboo) treatment (18.75) whereas in WXP (Without *Xylocopa* pollination) treatment only 6.45 numbers of fruits per plant was recorded. Similarly the XP3 treatment had the highest fruit set (36.59%), followed by XP2 treatment (36.11%), while the WXP treatment (12.60%) had the lowest fruit set. The XP3 treatment produced the highest yield ( $93.49 \pm 0.489$  q/ha), followed by XP2 ( $93.18 \pm 0.655$  q/ha), OP ( $82.34 \pm 0.503$  q/ha), XP1 ( $62.45 \pm 0.517$  q/ha), and WXP ( $23.90 \pm 0.950$  q/ha) treatments.

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# **Evaluation of certain plant products and chemicals against banana leaf and fruit scarring beetle, *Nodostoma subcostatum* Jacoby (Coleoptera: Chrysomelidae)**

*Karanika Gogoi*

Field experiments were conducted in the Horticulture Experimental farm, Department of Horticulture, Assam Agricultural University, Jorhat during 2020- 21 to evaluate certain plant products and chemicals against banana leaf and fruit scarring beetle, *Nodostoma subcostatum* Jacoby. The seasonal abundance of leaf and fruit scarring beetle on Dwarf Cavendish (Jahaji) was assessed on weekly basis from May, 2020 to April, 2021. The mean beetle population was highest during August, 2020 and the least was during January, 2021. Several meteorological factors have influenced the fluctuation of the scarring beetle population. For field evaluation, the treatments were applied at three critical stages of growth of the banana plant and among the treatments tested, imidacloprid 17.8 SL @20 g a.i./ha was the best effective treatment in all the three stages of the crop in reducing the beetle population i.e., at 3, 7 and 10 days after treatment, followed by NSKE 1500 ppm @3ml/L and lambda-cyhalothrin 5%EC @0.3ml/L. Among the plant extracts used, *Xanthium strumarium* @ 10 per cent stood out as the highest in minimizing the beetle population and the infestation over the other two plant extracts viz. *Lantana camara* and *Pongamia glabra* @10 per cent respectively. Imidacloprid 17.8 SL efficiently recorded as the best treatment in reducing the number of leaf scars per 5 cm<sup>2</sup> leaf surface area whereas *Pongamia glabra* was the least effective. Reduction in fruit damage was also exhibited best by imidacloprid 17.8 SL (8.23 %) treatment followed by NSKE 1500 ppm (12.44 %), lambda-cyhalothrin 5% EC (16.45 %), *Xanthium strumarium* (19.28 %), *Lantana camara* (34.10 %) and *Pongamia glabra* (36.4 %). The present experiment brought out a conclusion that plants which possess insecticidal properties can be used as an alternative for synthetic insecticides and also in combination with synthetic insecticides, it can further amplify the management strategies in reducing the pest damage.

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## **Efficacy of certain newer insecticides against termite, *Odontotermes obesus* and red ant, *Dorylus orientalis***

*Kasturi Sarmah*

The present study was carried out to evaluate the efficacy of three newer insecticides (imidacloprid 70 WG, clothianidin 50 WDG and thiamethoxam 25 WG) against termite, *Odontotermes obesus* and red ant, *Dorylus orientalis* during 2020-21 in the AINP- Soil Arthropod Pests Laboratory, Department of Entomology, AAU, Jorhat. Experimental findings revealed that among the three insecticides, thiamethoxam was found to be the most effective against termites with the highest per cent mortality of 42, 58, 74 and 95 per cent after 6, 12, 18 and 24 hours, respectively, at 100 ppm concentration. It was followed by clothianidin with 34, 45, 65 and 75 per cent mortality after 6, 12, 18 and 24 hours at 100 ppm concentration. For imidacloprid per cent mortality was registered as 33, 45, 62 and 68 per cent after 6, 12, 18 and 24 hours, respectively at 100 ppm concentration. The results also revealed that per cent mortality of termites increased gradually with increase in concentration as well as exposure period. The order of toxicity to *O. obesus* with respect to LC50 values at 24 hours after insecticidal treatment was thiamethoxam (2.59 ppm) > clothianidin (5.62 ppm) > imidacloprid (9.84 ppm). The order of toxicity with respect to LT50 values at 100 ppm concentration was thiamethoxam (8.22 hour) > clothianidin (11.32 hour) > imidacloprid (12.32 hour). Similarly, the data on mortality of *D. orientalis* revealed that among the three insecticides, thiamethoxam was found to be most effective with the highest per cent mortality of 64, 90, 100 and 100 per cent after 6, 12, 18 and 24 hours, respectively, at 1000 ppm concentration. Imidacloprid and clothianidin treatment registered per cent mortality 46, 58, 86, 98 and 26, 56, 98 and 100 per cent after 6, 12, 18 and 24 hours, respectively, at 1000 ppm concentration. Moreover, the per cent mortality of red ants increased gradually with increase in concentration of insecticides as well as exposure period. The order of toxicity to *D. orientalis* with respect to LC50 values after 24 hours exposure period was thiamethoxam (8.52 ppm) > clothianidin (14.93 ppm) > imidacloprid (31.88 ppm). The order of toxicity with respect to LT50 values at 1000 ppm concentration was observed as thiamethoxam (5.02 hour) > imidacloprid (7.53 hour) > clothianidin (9.03 hour).

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# **Population dynamics of mango fruit fly, Bactrocera dorsalis (Hendel) (Diptera:Tephritidae) and toxicity of certain insecticides against the pest**

*Manisha Urang*

The present investigation was carried out to study the „Population dynamics of *Bactrocera dorsalis* (Hendel) (Diptera:Tephritidae) and toxicity of certain insecticides against the pest“. The experiment was conducted at mango orchard, variety Amrapali, Experimental Farm, Dept. of Horticulture, and Residue Analysis Laboratory, Dept. of Entomology, Assam Agricultural University, Jorhat, Assam during the year 2020-2021. Methyl eugenol traps were used to study the population dynamics of the pest. During the study period from SMW 9 (26th Feb-4 th March) of 2020 to SMW 9 (26th Feb-4 th March) of 2021, two peak populations were found in the year 2020, on the SMW 14 and SMW 23, the mean capture being 78.66 and 78.00 flies respectively. The two peak populations were coincided with fruiting period and harvesting period of the crop. The number of flies captured in the traps had shown positive significant correlation with maximum and minimum temperature and negative significant correlation with morning relative humidity. Also the trap with wooden block for dispersion of methyl eugenol found more effective with hole size 1cm and total capture of 2352 flies than the ones with cotton wicks with total capture of 1064 flies. The percent fruit loss was found to be 13.39 per cent by *Bactrocera dorsalis* in mango variety Amrapali. From the study it was observed that after 24 and 48 hours of exposure, imidacloprid registered the highest (80% and 98%) mortality at 5 ppm and lowest (22% and 50%) mortality at 0.5 ppm concentration, emamectin benzoate gave the maximum (70% and 100%) mortality at 7 ppm and minimum (20% and 50%) mortality at 0.5 ppm concentration and lambda cyhalothrin gave the highest (76% and 98%) mortality at 5 ppm and lowest (34% and 64%) mortality at 0.05 ppm concentration. Lambda cyhalothrin showed lowest LC50 of 0.44 and 0.02 ppm after 24 and hours of treatment, respectively. The order of toxicity after 24 hours was lambda cyhalothrin > imidacloprid > emamectin benzoate. However, after 48 hours, the order of toxicity was lambda cyhalothrin > emamectin benzoate >

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imidacloprid Therefore, lambda cyhalothrin can be used as a component of spraying and bait trap in mango orchard coinciding with peak population period and can be included in IPM practices.

## **Morphological and Biochemical bases of resistance of certain chilli germplasms against yellow mite, *Polyphagotarsonemus latus* (Banks)**

*Nasreen Hussain*

The present experiment was carried out to investigate the morphological and biochemical bases of resistance of certain chilli germplasms against yellow mite. The experiment was conducted at Instructional-Cum-Research (ICR) Farm and Department of Entomology, Assam Agricultural University, Jorhat during 2020-21. The seasonal incidence of yellow mite of chilli was assessed on weekly basis from February, 2021 to May, 2021. Activity of yellow mite was observed from second week of February. The mean mite population was highest during last week of March, 2021 with 23.70 number of mites per 3 leaves and the least was found as 0.10 mites per 3 leaves during first week of May, 2021. The mean mite population showed significant negative correlation with evening relative humidity ( $r = -0.525$ ) and rainfall ( $r = -0.501$ ) whereas significant positive correlation ( $r = 0.525$ ) was shown with maximum temperature. Based on mean mite population, germplasms were categorized as, highly resistant (Moni, Yellow mem, Green mem, Krishna with 30 mites per 3 leaves). The correlation studies between the population of the yellow mite and different morphological and biochemical characters revealed that yellow mite had a significant negative correlation with trichome density ( $r = -0.847$ ), while leaf area had significant positive correlation ( $r = 0.651$ ). Among the biochemical parameters taken, total soluble sugar ( $r = 0.945$ ) and total soluble protein ( $r = 0.804$ ) had positive significant correlations with mite infestation and total phenolic compounds had significant negative correlation ( $r = -0.668$ ). Therefore, resistant germplasms had greater trichome density and higher phenolic compounds in leaves which conferred resistance against yellow mite. Thus, the desirable characteristics may be incorporated for development of resistant varieties through breeding.

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## **Evaluation of Cuelure against Fruit Fly, *Bactrocera cucurbitae* (Coquillett)**

*Nishigandha Kakati*

The present study was carried out to evaluate the efficacy of cuelure against fruit fly, *Bactrocera cucurbitae* (Coquillett). The experiment was conducted on cucumber and sponge gourd in Experimental Farm, Dept. of Horticulture, College of Agriculture, Assam Agricultural University; on ridge gourd, bitter gourd and sponge gourd in Farmer's field at Gohain gaon, Jorhat, Assam, India. during 2021-2022. Laboratory works were carried out in the Biocontrol Laboratory, Dept. of Entomology, College of Agriculture, Assam Agricultural University, Jorhat, Assam, India. Eight treatments were used with different combinations of ethyle alcohol (EA), cuelure (C) and emamectin benzoate (EB) such as T<sub>1</sub>(5EA: 5C: 1EB), T<sub>2</sub> (5EA: 4C: 1EB), T<sub>3</sub> (5EA: 3C: 1EB), T<sub>4</sub> (5EA: 2C: 1EB), T<sub>5</sub> (5EA: 1C: 1EB), T<sub>6</sub> (5EA: 0C: 1EB), T<sub>7</sub> (Cuelure) and T<sub>8</sub> (Mixture of molasses @ 5g/lit and profenofos 50EC @ 2ml/lit) as a check treatment. Among the eight treatments, T<sub>1</sub> captured the maximum number of fruit flies followed by T<sub>2</sub> in all the crops i.e., cucumber, sponge gourd, ridge gourd and bitter gourd, while T<sub>6</sub> had the lowest. Likewise, T<sub>1</sub> had the highest total catch (1241.50 flies) followed by T<sub>2</sub> (1237.25) and the lowest was found in T<sub>6</sub> (71.00 flies). Comparative abundance of fruit flies in three different cucurbitaceous crops, viz., ridge gourd, bitter gourd and sponge gourd during the peak activity period (June-July, 2022) showed that in all the three crops, maximum flies were trapped in T<sub>1</sub> followed by T<sub>2</sub> and the lowest was in T<sub>6</sub>. As compared to ridge gourd and sponge gourd, bitter gourd caught the highest flies per trap. Three different fruit fly species were collected from cuelure traps installed in cucurbit fields, which were *Bactrocera cucurbitae* (Coquillett), *Bactrocera tau* (Walker), and *Bactrocera dorsalis* (Hendel). *B. dorsalis* made up 72.73% of the entire population of trapped flies, followed by *B. tau* (15.30%) and *B. cucurbitae* (11.97%). The highest fruit fly population was found in 28th SMW and the lowest was found in 50th SMW; from SMW 52 to SMW 2 no flies were captured. The fly population showed a significant positive correlation with maximum temperature (0.704\*\*), minimum temperature (0.798\*\*), evening corelative humidity (0.536\*\*) and rainfall (0.550\*\*), but it showed a significant negative correlation with morning relative

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humidity (- 0.624\*\*). Per cent fruit damage was highest in bitter gourd (43.14%) in June to July followed by ridge gourd (31.02%) in June to July and sponge gourd grown in both April to June (26.95%) and June to July (25.38%). The lowest infestation was found in cucumber (14.58%) in December to January.

# **Effect of certain plant extracts against Tea looper; *Hyposidra talaca* Walker, Geometridae : Lepidoptera**

*Panchamika Dutta*

Laboratory experiments were conducted in the Department of Entomology, Assam Agricultural University, Jorhat during 2018-2020 to evaluate the bioefficacy of five different plant extracts which had been extracted with cold water viz., *Sapindus saponaria*, *Annona squamosa*, *Lantana camara*, *Vitex negundo* and *Xanthium strumarium* had been done against the larva of *Hyposidra talaca*. Different concentrations of plant extracts along with the untreated and a standard check (Deltamethrin 2.8 EC) were taken for comparison. The result reveal that the highest mortality of 90.0% at 10.00% concentration followed by 63.66%, 56.66%, 53.33%, 50% and 43.33% at 7.5%, 5%, 2.5%, 1% and 0.5% concentrations respectively at 72 hours after treatment when the larva were treated with *X. strumarium*. The data of *A. squamosa* showed lowest mortality of 56.83% at 10.00 % concentration followed by 53.5%, 46.8%, 40.1%, 36.76% and 20.03% at 7.5%, 5%, 2.5%, 1% and 0.5% concentration respectively at 72 HAT. The leaf extracts of all the five plant extracts reveals a dose and time dependent mortality over the exposure period. While investigating the toxicity of plant extracts, the LC50 values of, *S. saponaria*, *A. squamosa*, *L. camara*, *X. strumarium* and *V. negundo* were found to be 3.464%, 4.228%, 3.549%, 1.334% and 3.648% at 72 HAT. The order of toxicity with respect to LC50 of all the plant extracts was *Agora* (*Xanthium strumarium*)>*Monisaal* (*Sapindus saponaria*)>*Gu phool* (*Lantana camara*)>*Posotia* (*Vitex negundo*)>*Custard apple* (*Annona squamosa*). While evaluating the effect of LC50 of each plant extracts on growth and development of looper caterpillar, it showed a considerable changes in developmental duration. The developmental duration varied between 3.66days to 4.83days, 4.83days to 6.66 days, 5.33days to 7.66days, 5.00days to 6.66days, and 7.33days to 9.33days for LI, L-II, LIII, L-IV and LV respectively with the different LC50 of different plant extracts. Highest larval duration in all the instars of larva were shown by LC50 dose of *Xanthium strumarium* and lowest duration was shown by LC50 dose of *Annona squamosa*. Even it showed delay in pupal duration of treated larvae. Deformed adults were formed. They failed to oviposit and the adults could not survive a single day.

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## **Bioformulation of entomopathogenic fungus against *Helopeltis theivora* Waterhouse (Hemiptera: Miridae)**

*Priya Kaur*

Pathogenicity test of 5 strains or isolate of entomopathogens on adult *Helopeltis theivora* were carried out in the Physiology Laboratory, Department of Entomology, Assam Agricultural University, Jorhat during 2019-2021. Among the strains or isolate, *Archips* sp. isolate showed the best results at concentration  $1 \times 10^7$  conidia/ml. The radial growth of *Archips* sp. isolate was found to be 75.33 mm. At concentration  $1 \times 10^7$  conidia/ml, the conidial density, germination and pathogenicity of *Archips* sp. isolate was  $8.08 \times 10^7$  conidia/ml, 85.49% and 80%, respectively. Morphological characters of *Archips* sp. isolate were studied and its molecular characterization was carried out by using CP plant gDNA mini kit protocol and its accession no. was assigned as OM321438. While *Archips* sp. isolate when grown on liquid media supplemented with carbon, nitrogen and mineral sources (Glucose, Peptone and  $MgCl_2$ ), the medium supplemented with the mineral source  $MgCl_2$  (0.75%) showed maximum conidial load ( $6.54 \times 10^7$  conidia/ml) and maximum germination (88.91%). Three talc-based formulations were prepared. One was prepared by using base material as harvested from PDB supplemented with 0.75%  $MgCl_2$ , second with combination of all the nutrients (0.75% Glucose, 0.75% Peptone and 0.75%  $MgCl_2$ ) and third without nutrient. And among these formulations, all nutrients supplemented talc-based formulation showed maximum conidial density ( $11.52 \times 10^7$  conidia/ml) and germination (90.06%). Also, in order to increase the virulence and efficacy of the prepared bio-formulation, two stickers- Tween-80 and Triton-X@ 0.01% and two spreader oils-coconut oil and mustard oil@ 0.025% were tested. It was found that the formulation incorporated with Tween-80@ 0.01% and coconut oil @0.025% had maximum conidial load ( $13.12 \times 10^7$  conidia/ml) and spore germination (95.49%). Three doses viz., 5, 10, 15 gm/L were tested on the adults of *Helopeltis theivora*. Among these doses, the dose of 15 gm/L showed the highest mortality (88%) at 9th DOT.

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**Major Adviser: Dr. Purnima Das**



## Screening of rice varieties for resistance against *Sitophilus oryzae* (Coleoptera: Curculionidae)

*Priyanka Das*

The present investigation on screening of rice varieties for resistance against *Sitophilus oryzae* (Coleoptera: Curculionidae) was conducted in the Department of Entomology, Assam Agricultural University, Jorhat during 2020-21. Based on popularity and grouping on type of seed, altogether 16 numbers of rice varieties were selected to test the possible resistance reactions against *S. oryzae*. Moreover, both physical and biochemical basis of resistance against *S. oryzae* were assessed in husked and de-husked rice grains of the selected rice varieties. The data on seed damage recorded at 15, 30, 60, 90 and 180 days after release of *S. oryzae* revealed that the mean seed damage (%) was highest in Bahadur (husked) and Black rice (de-husked) after 180 days of infestation recording 24.67% and 93.67% seed damage, respectively, while the damage was lowest in Kon joha (husked) and Bokul joha (de-husked) with 11.67% and 53% seed damage, respectively. Moreover, the weight loss (%) was recorded to be the highest in Bahadur (8.81%) and Black rice (60.16%), while the least in Kon joha (2.90%) and Bokul joha (12.41%). The correlation studies between the mean damage percentage in husked rice with different physical and biochemical parameters revealed that damage percentage had a significant positive correlation with weight loss ( $r=0.865$ ), total soluble protein ( $r=0.862$ ), 1000 grain weight ( $r=0.741$ ), moisture content ( $r=0.536$ ), germination loss ( $r=0.886$ ) and seed vigor loss ( $r=0.536$ ) after 180 days of infestation. However, the mean damage percentage in de-husked grains showed significant positive correlation with weight loss ( $r=0.905$ ), starch content ( $r=0.982$ ), crude protein content ( $r=0.943$ ), L/B ratio ( $r=0.875$ ), 1000 grain weight ( $r=0.500$ ) and moisture content ( $r=0.869$ ) whereas crude fat content showed significant negative correlation ( $r= -0.640$ ) after 180 days of infestation. It is evident from the experiment that the rice grains having high percentage of starch, crude protein, total soluble protein, moisture content, L/B ratio, 1000 grain weight but low percent of crude fat content were more prone to damage caused by *S. oryzae*. In order to reduce seed damage caused by *S. oryzae* in susceptible rice varieties, a few edible plant products with known bio-efficacy against insect pests were viz., *Piper nigrum*, *Capsicum chinense*, *Zingiber officinale*, *Allium cepa*, *Cuminum cyminum* and *Allium sativum* were tested against the insect. The

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highest adult mortality was recorded in treatments with *P. nigrum* (100%) followed by *C. chinense* (100%), *C. cyminum* (98.33%), *A. sativum* (78.33%), *Z. officinale* (65%) and *A. cepa* (51.67%) at 96 hours after treatment at a dose of 10g/100g seeds with the LC50 values (g/100g of rice seeds) of 0.160 (*Piper nigrum*), 0.615 (*Capsicum chinense*), 0.785 (*Cuminum cyminum*), 4.656 (*Zingiber officinale*), 3.050 (*Allium sativum*) and 11.673 (*Allium cepa*) at 96 HAT, respectively indicating a strong potentiality in controlling *S. oryzae* under storage condition.

## **Population abundance of rice gundhi bug, *Leptocorisa* spp. and extent of damage caused by the pest in rice ecosystem**

*Priyanka Saikia*

Study on “Population abundance of rice gundhi bug, *Leptocorisa* spp. and extent of damage caused by the pest in rice ecosystem” was carried out in the three rice growing seasons, viz., sali (var. Ranjit), boro (var. Joymoti) and ahu (var. Disang) during 2020-21 at the field of Regional Agricultural Research Station, Titabor, Assam Agricultural University, Jorhat. Plant Inspection Method (PIM) was followed for assessing the rice gundhi bug population. In sali rice, the lowest population (0.05 gundhi bug per hill) was observed on 40th Standard Meteorological Week (SMW) and the highest (0.9 gundhi bug per hill) was recorded on 46th SMW during 2020. In boro rice, the lowest population (0.3 gundhi bug per hill) was recorded on 14th SMW and the highest of 3.75 gundhi bug per hill was recorded on 20th SMW during 2021. During ahu season, the lowest population (0.25 gundhi bug per hill) was recorded on 14th SMW and the highest (1.2 gundhi bug per hill) was on 19th SMW during 2021. On an average, the highest population of gundhi bug was observed in boro rice followed by ahu and sali. During sali season, population build up of gundhi bug showed significant positive correlation with morning relative humidity ( $r=0.734$ ) and bright sunshine hour ( $r=0.661$ ). Multiple regression analysis of rice gundhi bug population with different weather parameters showed 54.4 per cent variation in population in PIM. During boro and ahu rice the gundhi bug showed significant positive correlation with minimum temperature (boro,  $r = 0.600$ ; ahu,  $r = 0.649$ ), evening relative humidity (boro,  $r = 0.643$ ; ahu,  $r = 0.614$ ) and number of rainy days (boro,  $r = 0.742$ ; ahu,  $r = 0.710$ ). Multiple regression analysis of population of gundhi bug with different weather parameters showed 50.6 and 45 per cent variation of pest population in boro and ahu rice respectively. The extent of damage caused by rice gundhi bug was also recorded in sali, boro and ahu rice during the period of study. In sali rice, the lowest infestation of 4 per cent and the highest of 16.6 per cent were observed on 40th and 46th SMW during 2020, respectively. In boro rice, the lowest infestation of 9.3 per cent and the highest 24.5 per cent were observed on 18th and 20th SMW, during 2021, respectively. In ahu

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rice, the lowest infestation of 12 per cent and the highest 26.7 per cent were observed on 17th and 19th SMW, during 2021, respectively. On an average the highest grain damage per cent was observed in ahu rice followed by boro and sali rice. The population of gundhi bug showed significant positive correlation with extent of damage caused by the pest. 6 Study on the predatory efficiency of natural enemies on rice gundhi bug revealed that it was highest in tiger beetle, *Cicindela flavomaculata* (10.6%) followed by reduviid bug, *Rhynocoris* spp. (9.3%) and crab spider, *Thomisus* spp. (7.9%) without significant difference.

## **Exploring the Therapeutic Properties of Honey of Stingless Bees, *Tetragonula iridipennis* (Smith)**

*Puppala Sri Saranya*

The present investigation entitled “Exploring the therapeutic properties of honey of stingless bees, *Tetragonula iridipennis* (Smith)” was carried out under four heads viz., morphometric studies, brood rearing activities, correlation studies of brood, pollen and honey areas with weather parameters in apiary as well as Apiculture laboratory, Department of Entomology, Assam Agricultural University, Jorhat whereas biochemical analysis of honey of *T. iridipennis* was carried out in collaboration with Tezpur University during 2021-2022. A total of 20 morphometric characteristics of *T. iridipennis* were studied under ZEISS Stemi 2000-C microscope. The results revealed that the body length ranged from  $4.65\pm 0.29$  mm, head length was  $1.29\pm 0.11$  mm, head width was  $1.72\pm 0.07$  mm, thorax length was  $1.60\pm 0.06$  mm, thorax width was  $1.50\pm 0.15$  mm, abdomen length was  $1.84\pm 0.20$  mm, abdomen width was  $0.78\pm 0.11$  mm, antennal length was  $1.58\pm 0.04$  mm, compound eye length was  $0.85\pm 0.03$  mm, compound eye width was  $0.23\pm 0.01$  mm, ocellocular distance was  $0.16\pm 0.01$  mm, fore wing length was  $3.81\pm 0.10$  mm, fore wing width was  $1.34\pm 0.17$  mm, hind wing length was  $2.55\pm 0.21$  mm, hind wing width was  $0.64\pm 0.14$  mm, hamuli no. was 5, femur length was  $1.10\pm 0.04$  mm, femur width was  $0.25\pm 0.02$  mm, tibia length was  $1.53\pm 0.07$  mm, tibia width was  $0.45\pm 0.08$  mm. The morphometry of developmental stages and duration of different life stages were also studied. Study on brood rearing activities was carried out in three selected wooden stingless bee hives with specifications 15504 cc, 14364 cc and 6664 cc. The square paper grid method ( $5\times 5$  cm sq.) was followed to measure the brood, pollen and honey areas in each hive. The highest total brood area ( $1386.47\pm 42.63$  cm sq.) was observed in 15504 cc hive whereas the lowest ( $1359.58\pm 40.62$  cm sq.) was recorded in 6664 cc hive. The maximum brood area ( $217.96\pm 0.03$  cm sq.,  $218.45\pm 0.70$  cm sq. and  $211.91\pm 0.05$  cm sq.) was observed during February, 2022 whereas the minimum brood area ( $72.45\pm 3.60$  cm sq.,  $77.92\pm 1.40$  cm sq. and  $72.45\pm 3.61$  cm sq.) was recorded during June, 2022 in each wooden hive. Similarly, the pollen and honey areas were also determined. The maximum pollen area ( $146.83\pm 1.61$  cm sq.,  $146.30\pm 2.62$  cm sq. and  $150.40\pm 0.57$  cm sq.) was observed during January, 2022 while the lowest ( $75.16\pm 1.98$  cm sq.,  $75.03\pm 1.73$  cm sq. and  $74.11\pm 1.26$

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cm sq.) was observed during October, 2021 in the selected wooden hives. The maximum honey area ( $127.07 \pm 1.11$  cm sq.,  $121.51 \pm 0.51$  cm sq. and  $117.38 \pm 1.71$  cm sq.) was observed during January, 2022 and the lowest ( $77.57 \pm 2.02$  cm sq.,  $62.76 \pm 2.58$  cm sq. and  $63.99 \pm 2.10$  cm sq.) was recorded in July, 2022. A significant difference among the brood, pollen and honey areas was also observed during the present experiment. The correlation study exhibited a significant ( $P \leq 0.05$ ) negative correlation between inner hive temperature ( $^{\circ}\text{C}$ ) with that of brood ( $r = -0.817$ ,  $-0.800$  and  $-0.811$ ), pollen ( $r = -0.793$ ,  $-0.651$  and  $-0.813$ ) and honey ( $r = -0.742$ ,  $-0.774$  and  $-0.878$ ) areas of 15504 cc, 14364 cc and 6664 cc hives. Furthermore, a significant ( $P \leq 0.05$ ) positive correlation was observed between inner hive relative humidity (%) and brood areas of 14346 cc ( $r = 0.730$ ) and 6664 cc ( $r = 0.753$ ) hives. Studies on physico-chemical and antioxidant properties of stingless bee honey revealed that the therapeutic properties of honey is dependent upon the key parameters viz., pH ( $3.45 \pm 0.04$ ), EC ( $0.50 \pm 0.05$  mS/cm), moisture ( $23.50 \pm 1.32\%$ ), ash content ( $0.50 \pm 0.06\%$ ), HMF content ( $3.27 \pm 0.09$  mg/kg), crude protein ( $0.25 \pm 0.02\%$ ), crude fat ( $0.01 \pm 0.01\%$ ), crude fiber ( $0.12 \pm 0.02\%$ ), appearance/colour intensity (Dark amber color), reducing sugar ( $68.45 \pm 2.39\%$ ), total phenol content ( $597.92 \pm 3.05$  mg GAE/kg), total flavanoid content ( $99.85 \pm 1.60$  mg CEQ/kg). Furthermore, the elemental analysis determined the presence of various elements viz., Fe ( $3.78 \pm 0.16$  mg/kg), Ca ( $122.05 \pm 2.65$  mg/kg), Mn ( $5.27 \pm 0.05$  mg/kg), K ( $1180.44 \pm 3.10$  mg/kg), Mg ( $26.84 \pm 0.35$  mg/kg), Na ( $106.88 \pm 4.84$  mg/kg) and Zn ( $0.75 \pm 0.02$  mg/kg) necessary to enhance the medicinal properties of stingless bee honey.

## **Efficacy of Certain Biopesticides for Management of Litchi Mite, *Aceria litchii* Keifer**

*Ruby Hazowari*

Laboratory and field experiments were carried out in the Acarology Laboratory, Assam Agricultural University, Jorhat and Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat during 2021-2022 on organic approaches for management of litchi mite, *Aceria litchii* Keifer. Seasonal incidence of litchi mite population was also recorded for the same year in Assam condition. Bioassay study on laboratory evaluation of six biopesticides viz., *Nomurea anisopilae* liquid formulation, jatropha seed oil, pongamia seed oil, neem seed oil, castor seed oil and water pepper (*Polygonum hydropiper*) aqueous leaf extract along with propargite 57 EC revealed that among the six biopesticides, neem seed oil registered the highest mortality and least LC50 value of 0.079%, 0.043% and 0.026% after 24, 48 and 72 hours of treatment, respectively, at 0.2 % concentration. The results also revealed that per cent mortality of litchi mite in all the treatments increased gradually with increase in concentration as well as time over the exposure period. The order of toxicity against *A. litchii* with respect to LC50 values at 72 hours after treatment was – propargite (0.004%) > neem seed oil (0.026%) > jatropha seed oil (0.039%) > pongamia seed oil (0.045%) > castor seed oil (0.059%) > water pepper (*Polygonum hydropiper*) aqueous leaf extract (0.179%) > *Nomurea anisopilae* liquid formulation (0.613%). Correlation studies between the mean mite population and meteorological parameters during August, 2021 to July, 2022 showed significant positive correlation with maximum temperature and evening relative humidity and significant negative correlation with rainfall. The highest mite population density was recorded in the month of March and lowest was found during December. Field evaluation of the six biopesticides viz., *Nomurea anisopilae* liquid formulation, jatropha seed oil, pongamia seed oil, neem seed oil, castor seed oil and water pepper (*Polygonum hydropiper*) aqueous leaf extract against adult litchi mite, *A. litchii* along with standard check (propargite 57 EC) showed that the treatment propargite 57 EC @ 1ml/l recorded highest reduction in mite population i.e. 39.05%, 60.21% and 88.64% at 7, 14 and 21 days after treatment followed by water pepper aqueous leaf extract > *Nomurea anisopilae* liquid formulation > neem seed oil >

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jatropha seed oil > pongamia seed oil > castor seed oil at 7, 14 and 21 days after treatment. The results from the present investigation revealed that the biopesticides can be utilized as an effective alternative acaricide over the synthetic ones for control of litchi mite.



## **Insect-pest complex of sunflower, *Helianthus annus* L. under different nitrogen management practices**

*Rupam Das*

An experiment on “Insect pest complex of sunflower, *Helianthus annus* L. under different nitrogen management practices” was carried out in PG experimental plot, Department of Agronomy, Biswanath College of Agriculture during 2021-2022. The treatments consisted of different nitrogen management combinations including conventional urea and foliar application of conventional and nano urea. The experiment was laid out in RBD with 3 replications and 10 treatments viz. T1:Control check (No Nitrogen), T2: Soil application of 50% N, T3: Soil application of 100% N, T4: 3 foliar application of 0.6% nano urea ,T5: Soil application of 50% N + 2 foliar application of 1% conventional urea, T6: Soil application of 50% N + 2 foliar application of 2% conventional urea, T7: Soil application of 50% N + 2 foliar application of 3% conventional urea, T8: Soil application of 50% N + 2 foliar application of 0.2% nano urea, T9: Soil application of 50% N + 2 foliar application of 0.4% nano urea, T10: Soil application of 50% N + 2 foliar application of 0.6% nano urea. A total number of fifteen species under Hemiptera, Lepidoptera and Coleoptera orders were recorded as pests and four species of predators under Coleoptera and one spider species were recorded as natural enemies during the period of investigation. The population of aphid, *Aphis gossypii* Glover, whitefly, *Bemisia tabaci* Gennadius, Bihar hairy caterpillar, *Spilosoma obliqua* Walker and mealy bug, *Phenacoccus solenopsis* Tinsley were found significantly more in the conventional urea treated plot. Other insect pests were also found more in conventional urea-treated plots than nano urea. T1 (no nitrogen) and T2 (soil application of 50% N) had lower insect pest populations than the other and nano urea applied plots, but the yield was lower in T1 and T2. T9 (Soil application of 50% N + 2 foliar application of 0.4% nano urea) was found to be the best treatment followed by T10 (Soil application of 50% N + 2 foliar application of 0.6% nano urea) in case of yield. The correlation study showed that the bright sunshine hour had a positive and significant correlation with the whitefly population, relative humidity had a positive and significant correlation with aphid and leaf hopper population, aphid had positive and

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significant relation with maximum temperature and *S. obliqua* had negative and significant relation with relative humidity. The investigation showed that foliar application of nano urea is a better substitute for traditional urea in terms of lower insect pests population and increased yield.

## **Bioecology of Uzi Fly Infesting Mulberry Silkworm (*Bombyx mori* L.)**

*Rushali Chakraborty*

The present study was carried out to study the biology of uzi fly infesting mulberry silkworm and the natural enemy complex of the uzi fly during 2020-22 in rearing room of College of Sericulture and Laboratory of Department of Entomology, AAU, Jorhat. Experimental findings revealed that the uzi fly completed their life cycle in 28 to 42 days in case of males on an average of 34.5 days and 29 to 43 days in case of females and an average of 35.8 days which consist an average of 2.5 days incubation period, 7.10 days larval period, 15.55 days pupal period and the adult longevity was 9.40 days in case of male and 11.15 days in case of female. It is a serious endo-larval parasitoid of silkworm larvae causing 18% - 57 % damage in laboratory conditions depending on the larval instar and season. It was observed that the uzi fly infestation was high in the spring season than in the autumn season and the infestation was highest in the 4th and 5th instar larva than in the 3rd instar larva. The adult emergence percentage was found to be 86.34% in laboratory conditions and was highest in the soil as a pupation medium followed by sand, dried leaves and empty plastic containers. The sex ratio was found female to male ratio of 2.23:1. The fecundity of the female uzi fly was found to be 250.70 numbers on average with 40.10 eggs laid/day/female during 4.50 days of the oviposition period. There are three instars of maggots, first two instars remain inside the larval body, and the third instar after maturation comes out of the host body and undergoes pupation. A black scar on the silkworm body formed due to the penetration of maggot inside the host body after hatching and pierced cocoon formed when the maggot comes out for pupation were the two major characteristic symptoms of uzi fly infestation. There is only one natural enemy was found to be infesting the uzi fly pupa. The natural enemy was *Nesolynx thymus* belongs to the family Eulophidae of the order Hymenoptera. They were gregarious and laid eggs on the uzi fly pupa when kept in natural condition. The larvae bore inside the pupa and come out as adults.

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**Major Adviser: Dr. Roshmi Bora Dutta**

## **Compatibility of Two Native Entomopathogenic Fungi with Certain Botanicals and Their Efficacy against Termite, *Odontotermes obesus***

*Sanjay Hazarika*

Laboratory experiments were carried out to evaluate the compatibility of two entomopathogenic fungi viz., *Beauveria bassiana* and *Metarhizium anisopliae* with three different botanicals viz., neem oil, pongamia oil and jatropha oil at the Laboratory of Nanotechnology, Department of Plant Pathology, AAU, Jorhat. The potential compatible mixtures were also tested for their efficacy against termites (*Odontotermes obesus*) in the Laboratory of Soil Arthropod Pests, Department of Entomology, AAU, Jorhat. Compatibility testing was done by following poison food technique whereas the bioassay test was done by following the dry film technique. Compatibility testing data were analyzed through 3 factorial Completely Randomized Design (CRD) and bioassay data were analyzed by following CRD with 3 replications. Out of the three different botanicals tested, lowest inhibition was recorded in case of jatropha oil (53.102%) followed by neem oil (53.624%) towards both the entomopathogenic fungi which were recorded to be at par with each other. Significantly higher inhibition (67.428%) of the entomopathogenic fungi was recorded in case of pongamia oil. Experimental results further revealed that the per cent inhibition of different botanicals against *B. bassiana* (45.503%) was significantly lower (at  $P=0.05$ ) as compared to the *M. anisopliae* (70.599%). Out of the six different concentrations used for the study, the lower two concentrations of each botanicals exhibited significantly lower inhibition (41.746 and 42.605%) as compared to rest of the concentrations. From the above study, the four best compatible mixtures i.e. *B. bassiana*+neem oil (0.10%), *B. bassiana*+neem oil (0.20%), *B. bassiana*+jatropha oil (1.5%) and *B. bassiana* + jatropha oil (2%) were tested for their efficacy against termites along with an untreated control. It was vivid from the results that the combined application of *B. bassiana*+neem oil @ 0.20 per cent concentration recorded highest mortality of termites i.e. 10.00, 23.33, 36.67, 51.8, 81.85 and 100 per cent after 12, 24, 48, 72, 96 and 120 hours, respectively which was significantly superior to the rest of the treatments after 48 hours. *B. bassiana* + jatropha oil @ 2.0 per cent

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concentration registered 6.67, 20.00, 30.00, 44.44, 64.08 and 77.78 per cent mortality after 12, 24, 48, 72, 96 and 120 hours, respectively which was followed by the application of *B. bassiana*+neem oil @ 0.10 per cent (6.67, 16.67, 26.67, 40.74, 60.74 and 70.37 % mortality after 12, 24, 48, 72, 96 and 120 hours, respectively) and *B. bassiana*+jatropha oil @ 1.5 per cent (3.33, 13.33, 20.00, 27.04, 42.59 and 55.56 % mortality after 12, 24, 48, 72, 96 and 120 hours, respectively). The lowest mortality was recorded in case of untreated control (3.33, 6.67 and 10.00% after 72, 96 and 120 hours, respectively).

## **Evaluation of AAU Jatropha oil formulation on white grub, *Lepidiota mansueta* Burmeister and termite, *Odontotermes obesus* Rambur**

*Shareen Tikhak*

Laboratory experiments were carried out in the Chemical Ecology Laboratory, Department of Entomology, Assam Agricultural University (AAU), Jorhat during 2021-22 to evaluate the different concentrations of AAU Jatropha oil formulation against white grub, *Lepidiota mansueta* Burmeister and termite, *Odontotermes obesus* Rambur where the insecticide “clothianidin 50WDG” was taken as check. Similarly, treatments consisting of only the adjuvants in the formulation (excluding Jatropha oil) were used to check their probable efficacy on test insects individually and also with different combination. Experimental findings of *L. mansueta* revealed that at 7% concentration, the highest per cent mortality was observed which were 37, 58, 72 and 88 per cent after 48, 72, 96 and 120 hours, respectively. The least mortality of *L. mansueta* were 14, 32, 50, 62 per cent which was observed at 1% concentration of AAU Jatropha oil formulation after 48, 72, 96 and 120 hours, respectively. The results also revealed that per cent mortality increased gradually with increase in concentration as well as exposure period. However, the adjuvants of AAU Jatropha oil formulation showed no effect on the mortality of *L. mansueta*. The LC50 values of AAU Jatropha oil formulation at 48, 72, 96, 120 hours exposure were found to be 25.298, 18.585, 2.847 and 1.160 per cent, respectively. The highest LT50 value was obtained at 1 % concentration which was 112.206 hrs. and the lowest was recorded as 68.719 hrs. at the highest concentration of the formulation. The experimental findings of *O. obesus* revealed that at 7 % concentration, the highest per cent mortality were observed which were 30, 40, 52, 68, 86, 94 per cent after 6, 9, 12, 24, 48, 72 hours, respectively. The least mortality of *O. obesus* were 6, 16, 26, 36, 62, 74 per cent observed at 1 % concentration of AAU Jatropha oil formulation after 6, 9, 12, 24, 48, 72 hours, respectively. The results also revealed that per cent mortality increased gradually with increase in concentration as well as exposure period. The adjuvants of AAU Jatropha oil formulation showed no effect on the mortality of *O. obesus*. The LC50 values of AAU Jatropha oil formulation

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at 6, 9, 12, 24, 48, 72 hours exposure were found to be 30.417, 25.719, 16.595, 5.089, 1.040, 0.814 per cent, respectively. The highest LT50 value was obtained at 1 % concentration which was 43.186 hrs. and the lowest was recorded as 15.020 hrs. at the highest concentration of the formulation.

## **Effect of Pollen Substitutes on Growth and Development of Honey Bee, *Apis cerana indica* F.**

*Udeshna Borgohain*

The present study was carried out to find out the “Effect of pollen substitutes on growth and development of honey bee, *Apis cerana indica* F.” Seven pollen substitutes viz., T<sub>1</sub>(PAU pollen substitute), T<sub>2</sub> (Pant Nagar pollen substitute, T<sub>3</sub> (YSPUHF, Solan pollen substitute), T<sub>4</sub> (Corbicular pollen feeding), T<sub>5</sub> (OUAT, pollen substitute), T<sub>6</sub> (AAU, pollen substitute), and T<sub>7</sub> (Sugar solution) were tested during 2021-2022 in the colonies of ICR Farm, AAU, Horticultural Orchard, AAU, and Apiary and Apiculture Laboratory, Department of Entomology, AAU, Jorhat. Experimental findings revealed that the highest honey area (15.70±0.09cm<sup>2</sup> ) and (22.63±0.13 cm<sup>2</sup> ) was observed in treatment 4 (corbicular pollen feeding) after 7 days and 15 days of treatment, respectively, while the lowest was recorded in treatment 7 that was control (sugar solution) with the honey area (10.72±0.07cm<sup>2</sup> ) and (15.66±0.21cm<sup>2</sup> ). The maximum pollen area (10.86±0.52cm<sup>2</sup> ) and (15.63±0.07cm<sup>2</sup> ) was observed after 7 days and 15 days in treatment 4, whereas the lowest was found to be 5.94±0.67cm<sup>2</sup> and 8.63±0.09cm<sup>2</sup> after 7 days and 15 days, respectively in treatment 7. The maximum brood area was observed after 7 days and 15 days of treatment in treatment 4 were 17.96±0.03 cm<sup>2</sup> and 20.27±0.06cm<sup>2</sup> and the lowest was found to be 11.17±0.02cm<sup>2</sup> and 12.92±0.10cm<sup>2</sup> at treatment 7. The colony strength was found to be maximum (6.63±0.06nos. and 7.57±0.17nos.) in treatment 4 and the minimum (5.60±0.06nos. and 6.40±0.09nos.) at treatment 7 that is sugar solution after 7 days and 15 days, respectively. The fecundity of queen bee was found to be maximum (104.61±1.25nos. and 117.45±1.08nos.) in the colony treated with treatment 4, while the fecundity of queen bee was found to be minimum (81.46±0.58nos. and 89.32±0.34nos.) in treatment 7 after 7 days and 15 days of treatment, respectively. The consumption of pollen substitutes was found to be highest (32.44±1.87%), (76.02±0.85%) and (98.45±0.63%) in treatment 4 after 2 days, 4 days and 6 days of treatment and the lowest (22.54±1.06%), (70.58±1.01%) and (84.49±1.25%) was found in treatment 7 after 2 days, 4 days and 6 days of treatment, respectively. The egg period, larval period and pupal period were not affected significantly by the tested pollen substitutes. The weight

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of the larvae was found to be maximum ( $0.33\pm 0.01\text{gm}$ ) after 5 days of treatment in treatment 4 and the lowest ( $0.26\pm 0.01\text{gm}$ ) was found after 5 days of treatment in treatment 7. The weight of the pupae was found to be maximum ( $0.37\pm 0.01\text{gm}$ ) after 12 days of treatment in treatment 4 and the lowest ( $0.29\pm 0.01\text{gm}$ ) was found after 12 days of treatment in treatment 7. The various meteorological factors viz., temperature, relative humidity and rainfall influenced the brood area, weight of larvae and pupae. Maximum temperature and maximum relative humidity showed positive correlation with brood area, weight of larvae and pupae. On the other hand, minimum temperature, minimum relative humidity and rainfall showed negative correlation with brood area, weight of larvae and pupae.

## **A study on knowledge and adoption of recommended plant protection formulations by small tea growers of North Bank Plains Zone of Assam**

*Bikkey Halder*

The present study entitled “A study on knowledge and adoption of recommended plant protection formulations by small tea growers of North Bank Plains Zone of Assam” was carried out with the following objectives: 1. Identify the different types of plant protection formulations applied on tea plantation by the small tea growers 2. Assess the level of knowledge and extent of adoption of recommended plant protection formulations by the small tea growers 3. Find out the pesticide application safety measures followed by the small tea growers 4. Explore the relationship, if any, of selected characteristics of small tea growers with the level of knowledge and extent of adoption of recommended plant protection formulations The present study was conducted in the North Bank Plains Zone of Assam. The North Bank Plains Zone consists of 6 districts. Out of these, 2 districts were selected purposively based on the presence of large number of small tea growers inhabited in the selected areas viz., Biswanath and Sonitpur. From each selected district, one subdivision with maximum number of small tea growers was selected purposively. From each of the selected subdivisions, 2 blocks were selected randomly. A list of the small tea growers of each of the selected blocks was prepared with the help of the office of the tea board and concerned block development officers from the selected blocks from which 16 per cent of the total tea growers was selected as the sample. Thus, from the population of 1200 growers, a sample of 192 small tea growers was selected for the study. The primary data for the study were collected by the personal interview method with the help of a structured research schedule during the period from April, 2021 to September, 2021. Keeping in view the objectives of the study, 2 dependent and 16 independent variables were included in the study. The level of knowledge and extent of adoption of recommended plant protection formulations by the small tea growers was treated as the dependent variables in the study. Procedure for measuring level of knowledge was followed using knowledge test developed for the study and the procedure for measuring extent of

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adoption was followed in the light of the procedure used by Borah (2017). The independent variables included in the study were age, education level, area under tea plantation, occupational status, social participation, experience as small tea grower, availability of working capital, net annual income from tea cultivation, exposure to training, utilization of information source, farm mechanization, economic motivation, management orientation, risk bearing ability, scientific orientation and decision making ability. The statistical techniques and tests used in the study for analysis and interpretation of the data were frequency, percentage, arithmetic mean, standard deviation, co-efficient of variation, multiple correlations, multiple regression and t-test for testing the significance of the coefficients for correlation and regression analysis. ii Findings revealed that majority of the respondents (64.05 %) belonged to the middle aged group while 27.60 per cent of the respondents belonged to the old aged group. Majority of the respondents (34.89 %) had high school level of education followed by 27.08 per cent respondents with middle school level of education and 21.36 per cent having higher secondary level education. Majority of the respondents (69.27 %) were small growers having land area from 1.00 to 2.00 ha under tea plantation followed by 29.96 per cent respondents having land area from 2.10 to 4.00 ha under tea plantation. Majority of the respondents (68.75 %) had only cultivation as occupation followed by 17.71 per cent of respondents having cultivation + skilled labour as occupation. Majority of the respondents (49.48 %) had membership of one organization followed by 33.33 per cent of respondents with no membership. Majority of the respondents (79.68 %) had medium term experience as small tea grower followed by 16.15 per cent of respondents with long term experience as small tea grower. Majority of the respondents (72.39 %) had medium availability of working capital, medium net annual income from tea plantation (79.17 %). Majority of the respondents (71.35 %) had medium level of training exposure followed by 22.39 per cent respondents with low level of training exposure. Majority of the respondents (65.10 %) had medium information source utilization followed by 20.84 per cent of respondents with low information source utilization. Majority of the respondents (69.27 %) had medium level of farm mechanization. Majority of the respondents (77.60 %) had medium level of economic motivation, medium level of management orientation (60.42 %), medium risk bearing ability(69.79 %), low level of scientific orientation (41.66 %) and medium level of decision making ability(80.73 %). Findings revealed that with respect to acaricides majority of the respondents (87.50 %) used fenpyroximate 5EC formulation followed by 72.39 per cent of respondents who used spiromecifen 22.9 SC formulation. Under insecticides, majority of the respondents (88.54 %) used thiacloprid 21.7 SC formulation followed by 86.46 per cent of respondents who were found to use emamectin benzoate 5 SG formulation. Similarly with respect to fungicides, more than three-fourth (79.68 %) of the respondents were found to use copper oxychloride formulation followed by 47.91 per cent of the respondents who used hexaconazole 5 EC formulation. In case of herbicides, only 15.10 per cent of the growers used glyphosate 41 SL formulation followed by 7.81 per cent of them who were found to use paraquat dichloride 4 WSC

formulation. A very small proportion of them (2.60 %) were found to use *Beauveria brassiana* 2.5% WP formulation which is a bio-pesticide. With regards to level of knowledge on recommended plant protection formulations majority of the respondents (58.85%) had medium level of knowledge on recommended plant protection formulations followed by 25.00 per cent of respondents with low level of knowledge on recommended plant protection formulations. Only 16.15 per cent of the respondents were found to have high level of knowledge on recommended plant protection formulations. The findings revealed that majority of the respondents (71.87 %) had medium extent of adoption of recommended plant protection formulations followed by 21.88 per cent of the respondents having low extent of adoption of recommended plant protection iii formulations. Only 6.25 per cent of respondents were found to have high extent of adoption of recommended plant protection formulations. The findings with respect to pesticide application safety measures revealed that majority of the respondents (75.52 %) store the pesticides away from reach of the children and live stocks followed by 65.50 per cent respondents who often wash their hands and face with clean water and soap after spraying pesticides. Moreover purchasing of pesticides in well packed containers, purchasing of pesticides from registered pesticide dealers having valid license and storing place of pesticides should be well protected from direct sunlight and rain are the next important safety measures that were followed by 59.37 per cent, 54.16 per cent and 50.00 per cent respondents respectively. Findings of correlation analysis indicated that out of the 16 selected independent variables, 10 independent variables were significantly correlated with farmers' level of knowledge on recommended plant protection formulations. Among the 10 independent variables, 9 variables viz., education level, social participation, experience as tea grower, exposure to training, utilization of information source, farm mechanization, management orientation, scientific orientation and decision making ability had significant and positive correlation with the level of knowledge on recommended plant protection formulations at 0.01 level of probability and 1 variable viz., occupational status showed significant and positive correlation with the level of knowledge at 0.05 level of probability. The variables which were found to have significant correlation with the level of knowledge were further selected for multiple regression analysis with a view to determining the relative influence of those variables in predicting the variation in the level of knowledge on recommended plant protection formulations by the small tea growers. The predictive power of multiple regression was estimated with the help of coefficient of multiple determination ( $R^2$ ) and adjusted  $R^2$ . Out of 10 independent variables, only 7 variables, viz., education level, social participation, utilization of information source, scientific orientation, decision making ability, occupational status and farm mechanization were found to contribute significantly towards variation in the farmers' level of knowledge on recommended plant protection formulations Five variables, viz., education level, social participation, utilization of information source, scientific orientation and decision making ability showed significant contribution towards level of knowledge at 0.01 level of probability and only two variable viz.,

occupational status and farm mechanization showed significant contribution towards the level of knowledge on recommended plant protection formulations at 0.05 level of probability. The value of  $R^2$  (0.806) indicated that 10 independent variables selected for the study were efficient in predicting the level of knowledge on recommended plant protection formulations. The value of adjusted  $R^2$  (0.795) indicated that the independent variables fitted in the regression equation could actually explain 79.50 per cent of the variation in the level of knowledge on recommended plant protection formulations. Findings of correlation analysis indicated that out of the 17 selected independent variables, 11 independent variables were significantly correlated with the extent of adoption of recommended plant protection formulations. Among the 11 independent variables, 10 variables viz., education level, area under tea, occupational status, exposure to training, utilization of information source, economic motivation, risk bearing ability, scientific orientation, decision making ability and knowledge level had significant and positive correlation with the extent of adoption of recommended plant protection formulations at 0.01 level of probability and 1 variable viz., experience as small tea grower showed significant and positive correlation with the extent of adoption at 0.05 level of probability. The variables which were found to have significant correlation with extent of adoption were further selected for multiple regression analysis with a view to determining the relative influence of those variables in predicting the variation in the extent of adoption of recommended plant protection formulations by the small tea growers. The predictive power of multiple regression was estimated with the help of coefficient of multiple determination ( $R^2$ ) and adjusted  $R^2$ . Out of 11 independent variables, only 5 variables, viz., education level, economic motivation, knowledge level, risk bearing ability and decision making ability were found to contribute significantly towards variation in the extent of adoption of recommended plant protection formulations. Three variables, viz., education level, economic motivation and knowledge level showed significant contribution towards extent of adoption at 0.01 level of probability and only two variable viz., risk bearing ability and decision making ability showed significant contribution towards extent of adoption of recommended plant protection formulations at 0.05 level of probability. The value of  $R^2$  (0.770) indicated that 11 independent variables selected for the study were efficient in predicting the extent of adoption of recommended plant protection formulations. The value of adjusted  $R^2$  (0.757) indicated that the independent variables fitted in the regression equation could actually explain 75.70 per cent of the variation in the extent of adoption of recommended plant protection formulations.

# **Impact Assessment of Integrated Farming System Units of Kvk's Established under Rashtriya Krishi Vikas Yojana**

*Chappidi Venkata Pujitha*

The present study was conducted with trained and untrained farmers under KVK Jorhat, KVK Sivasagar and KVK Golaghat of Assam with the objectives to determine the level of knowledge and extent of adoption of IFS units, variance in the level of knowledge, income and extent of adoption between trained and untrained farmers and the factors influencing the knowledge and adoption of the respondents and the problems faced by the trained farmers in adopting IFS units along with their suggestive measures. A multistage purposive cum random sampling design was followed for selecting 120 respondents for the study. Appropriate statistical tools viz. frequency, percentage, arithmetic mean, standard deviation, ranking, t-test, Pearson's correlation, chi-square and regression were used to analyse and interpret the data according to the objectives. The utilization study was conducted by considering three criteria i.e. production purpose, demonstration purpose and training purpose and KVK Jorhat was found to have better performance. The analysis of the profile characteristics of the trained and untrained farmers revealed that the majority (62.2% and 43.3%) of the farmers belonged to the age group of 36 to 50 years and had high secondary education in trained farmers and middle school level in untrained farmers, had medium level (54.44% and 50) of annual income, had medium level (56.66 and 66.66%) of farming experience, had marginal level of land holding (41.11% and 40%), practiced 2-3 times (61.11%) of resource recycling in trained farmers and majority (76.66%) no recycling in untrained farmers. Both trained and untrained farmers had medium level (55.55% and 43.33%) of material possession, trained farmers had most of the credit availability from commercial banks (46.66%) and untrained farmers from money lenders (50%), majority had a market accessibility of once in a month (35.55% and 33.33%), exactly half of the respondents had medium level of extension contact, majority had medium level (62.22% and 50%) of risk preference and majority had medium level (56.66% and 70%) of innovativeness. The trained farmers had medium level (63.33%) of overall knowledge whereas untrained farmers had low level (66.66%) of knowledge, in overall extent of

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adoption trained farmers had medium (67.77%) and untrained farmers had low (70%) adoption and in case of income from IFS majority had medium level of income (63.3% and 56.6%). The change in the contribution of paddy, poultry, piggery and fishery is 6.22%, -5.40%, 5.33% and 27.73% respectively. The statement analysis of selected practiced of paddy, poultry, piggery and fishery components shows that in case of knowledge there is similar level of knowledge in trained and untrained farmers and in case of extent of adoption there was wide difference between trained and untrained farmers. When compared the knowledge, income and adoption by using t-test, it is concluded that there is a significant difference of the trained and untrained farmers. Education, farming experience, annual income, extension contact, trainings undergone, resource recycling and innovativeness were found to have a significant association with level of knowledge and extent of adoption of IFS units. When compared the contribution of independent variables to dependent variables by using regression, 84.2% and 86.1% contribution is identified. High capital investment for the establishment of IFS unit, Non- availability of HYVs for paddy and breeds in poultry and piggery, shortage of labour and lack of skills in family labour are some problems faced by farmers. Timely provision of high quality agricultural inputs and implements, upgrading the skills of family labours about IFS unit, government should provide subsidies or loans for establishment of IFS unit, provision of timely credit supply through funding agencies are some suggestions proposed by farmers.

# **Effectiveness of Online Teaching-Learning among Agricultural Students during Covid-19 Pandemic: A Study on Students at Assam Agricultural University, Jorhat**

*Chaya Snigdha Deka*

Online teaching and learning have played a significant role, thus helping in the emergence of virtual class learning (Dey and Ghosh, 2020). The study entitled “Effectiveness of Online Teaching-Learning among Agricultural Students’ during COVID-19 Pandemic: A Study on students’ at Assam Agricultural University, Jorhat” was a descriptive study done by conducting an online survey amongst the undergraduate students at the College of Agriculture, Jorhat. The survey was conducted in a questionnaire in Google Form and distributed among the students via emails. A total sample size of 250 students were taken through stratified random sampling out of which 91 students responded to the questionnaire. The study was conducted to know students' perception of the technology used by AAU in conducting online classes during the pandemic and experience on online learning along with problems related to financial, mental, emotional and others. The study touched on the points related to students' perspectives on the issues related to online learning. The study found that most students use smartphones to take online classes (43.50 %). Most students used Google Classroom (97.80 %). In contrast, most students think Google Meet is a useful online teaching tool (92.3 %). Teachers most used Google Meet and Google Classroom together (50.54 %). Students have a moderate level of perception of the technology used by AAU for online classes. The most severe issue students faced during online classes was poor internet connectivity (52.75 %). According to the research findings, online teaching learning platforms can be used as an alternative teaching and learning method for the agricultural discipline, as the current situation has compelled the educational system to shift to this new way of learning.

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# **A study on the farmers' preference of High Yielding Varieties of rice released by Assam Agricultural University in Upper Brahmaputra Valley Zone of Assam**

*Debangajyoti Borgohain*

Assam occupies an unique position in the world of rice production. Because of the favourable weather conditions, farmers prefer to sow rice. Using science and technology, the state has continued to make innovative attempts to increase rice yield. The study's aim was to learn more about farmers' preferences for high-yielding rice varieties released by the Assam Agricultural University in Upper Brahmaputra Valley Zone of Assam. With this information, it was attempted to manifest the socio-economic situations of rice growers through varietal preference and attribute selection at various Agro-Ecological Situation (AES), with the following objectives in mind: 1. To study the desired attributes in selection of rice varieties by the farmers under different Agro-Ecological situations. 2. To assess the preference of farmers between a set of selected AAU released high yielding varieties and local varieties of rice. 3. To identify the problems faced by the farmers in cultivating the HYVs of Rice. Three districts in the Upper Brahmaputra Valley Zone of Assam were chosen, and ricedominated agro-ecological situations were purposefully chosen for the study within these three districts. Each AES had one village chosen at random. With the support of a suitably planned timetable, a total of 120 respondents divided into 40 respondents in each district were questioned. In the three districts studied, the area under HYVs was found to be less than that under traditional rice types. Cropping intensity was likewise determined to be moderate. The Majority of farmers do not avail credit from financial institutions. Other factors such as Education, Family type, Family size, Extension contact, Risk orientation, Economic incentive, and a few more were investigated. Farmers in all three districts considered "High yield," "Higher market price," "Tolerance to pest and disease," "Taste," "Aroma," and few other characteristics while choosing to adopt/cultivate a rice variety. Only a few farmers' perceptions of a few qualities changed between AES of different districts, according to the findings. Preferential ranking was used in conjunction with Kruskal-wallis and Paired t-test to statistically determine rice varieties

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preferences. Traditional varieties were cultivated more than hybrid varieties in Golaghat (Kon Joha), Sibsagar (Soi Lahi), and Tinsukia (Bihari), according to the findings. 'Ranjit' a variety released by AAU was grown in Golaghat and Tinsukia whereas 'Ranjit sub-1' was grown in Sibsagar among the HYVs. In comparison to the other districts, Sibsagar grew more HYVs, whereas Tinsukia grew more traditional cultivars. The major issues and constraints that the respondents faced were also investigated, and identified, viz. high input costs, lack of trust in new technology, limited village extension activities and high HYV seed costs were few which farmers in all three districts faced.

## **A study on knowledge and adoption of organic farming practices of black rice (Chak-Hao) by the farmers of Manipur**

*Kharibam Kabita Devi*

The present study entitled “A study on knowledge and adoption of organic farming practices of black rice (Chak-Hao) by the farmers of Manipur” was carried out with the following objectives: 1. Study the personal, socio-economic, psychological and communication characteristics of farmers associated with organic cultivation practices of black rice 2. Assess the farmers’ level of knowledge and extent of adoption of recommended organic cultivation practices of black rice by the farmers 3. Find out the factors influencing farmers’ level of knowledge and extent of adoption of recommended organic cultivation practices of black rice by the farmers 4. Identify the constraints as perceived by the farmers in production and marketing of organic black rice The study was undertaken in Imphal West and Kakching districts of Manipur which were selected purposively, as these two districts had the larger area under organic black rice cultivation. The Patsoi sub-division from Imphal West district and the Waikhong sub-division from Kakching district were selected purposively as these two sub-divisions had larger area under organic black rice cultivation. From Patsoi subdivision, three villages namely Kamong, Heigrujam and Ngairangbam were selected purposively on the basis of highest number of black rice cultivating farmers. From Waikhong sub-division, three villages namely Wangoo, Sugnu and Khongyam were selected purposively on the basis of highest number of organic black rice cultivating farmers. For each of the selected villages, a list of organic black rice cultivating farmers was prepared from which 50 per cent of the total farmers was selected to the sample following proportionate allocation method. Thus, from the population of 160 farmers, a sample of 80 farmers were selected for the study. The primary data for the study were collected by the personal interview method with the help of a structured research schedule during the period from April, 2020 to September, 2020. Keeping in view the objectives of the study, 19 independent variables and 2 dependent variables were included in the study. The independent variable included in the study were Age, Education level, Farming experience, Type of family, Family size, ii Size of operational land holding, Area under

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black rice cultivation, Farm mechanization, Annual farm income, Annual net income from black rice production, Extension contact, Mass media exposure, Exposure to training, Scientific orientation, Decision making ability, Achievement motivation, Economic motivation, Management orientation and Risk bearing ability. The dependent variables included in the study were farmers' level of knowledge of recommended organic cultivation practices of black rice and extent of adoption of recommended organic cultivation practices of black rice by the farmers which was measured by using the procedure used by Borah (2017). The statistical techniques and tests used in the study for analysis and interpretation of the data were frequency, percentage, arithmetic mean, standard deviation, co-efficient of variation, multiple correlations, multiple regression and t-test for testing the significance of the coefficients for correlation and regression analysis. Findings revealed that majority of the respondents (56.25%) belonged to middle aged category followed by 37.50 per cent of respondents in old aged category. The rest 6.25 per cent of the respondents belonged to young aged category. Majority of the respondents (31.25%) had middle school level of education and again 31.25% had Graduate/diploma and above level of education followed by 22.50 per cent respondents with high school level of education, 10.00 per cent with higher secondary /PU level of education. 5.00 per cent of the respondents were illiterate but there were no 'can read only' and 'can read and write/primary level' category respondent in the sample of the study. Great majority of the respondents (81.25%) had medium (5-8 years) experience of organic black rice farming followed by 10.00 per cent respondents with long term experience (9 years and above). Only 8.75 per cent of the respondents had short term experience (Up to 4 years) of organic black rice cultivation. Most of the respondents (61.25%) belonged to the nuclear family type and the rest 38.75 per cent belonged to the joint family type and majority of the respondents (66.25%) had small family size (having up to 5 members) and rest 33.75 per cent had large family size (having up above 5 members). More than half of the respondents (56.25%) belonged to the small category of operational land holding size followed by marginal land owners 35.00 per cent and 7.50 per cent of the respondents with semi-medium land holding while only 1.25 per cent of the respondents belonged to the medium land holding category. No respondents were found in the large land holding category. Great majority of the respondents (85.00%) were having land area from 0.23 to 0.76 ha under organic black rice cultivation followed by 7.50 per cent respondents having land area from 0.76 to 2.0 iii ha under organic black rice cultivation. Again 7.50 per cent of the respondents had land area up to 0.22 ha under organic black rice cultivation. In case of farm mechanization majority (62.50%) of the respondents were having medium level of farm mechanization, followed by 18.75 per cent with high level of farm mechanization and the remaining 18.75 per cent were having low level of farm mechanization. Majority of the respondents (56.25%) had medium annual farm income ranging from Rs 110038 to Rs 520891 followed by 38.75 per cent respondents with low annual farm income ranging from Rs 45300 to Rs 110037 while only 5.00 per cent of them had high annual farm income ranging from Rs 520892 to Rs 747000. Regarding the net farm income from

organic black rice production, majority of the respondents (78.75%) had medium net income ranging from Rs 37451 to Rs 83906 followed by 11.25 per cent respondents with low net income ranging from Rs 25500 to Rs 37450 and 10.00 per cent of them had high net income ranging from Rs 83907 to Rs 125000. Majority of the respondents (75.00%) had medium level of extension contact followed by 20.00 per cent with low level of extension contact and only 5.00 per cent of the respondents were found with high level of extension contact. Majority of the respondents (63.75%) had medium mass media exposure, followed by 23.75 per cent with low mass media exposure. Only 12.50 per cent of the respondents had low mass media exposure and majority of the respondents (81.25%) had medium level of exposure to training followed by 23.75 percent respondents with high level of exposure to training and only 7.50 percent respondents with low level of exposure to training. Majority of the respondents (46.25%) had low level of scientific orientation followed by 36.25 per cent respondents with medium level of scientific orientation and 17.50 per cent respondents with high level of scientific orientation. Majority of the respondents (60.00%) had low level of decision making ability followed by 33.75 per cent respondents with medium level of decision making ability and only 6.25 per cent respondents with high level of decision making ability. Most of the respondents (68.75%) had medium level of achievement motivation followed by 25.00 per cent respondents with low level of achievement motivation and only 6.25 per cent of them had high level of achievement motivation. Majority of the respondents (52.50%) had medium level of economic motivation followed by 32.50 per cent respondents with low level of economic motivation and 15.00 percent respondents with high level of economic motivation and majority of the respondents (71.25%) had medium level of management orientation followed by 17.50 per cent respondents with low level of management orientation. Only 11.25 per cent of the respondents were found with high level of management orientation. Majority of the respondents (67.50%) had medium level of risk bearing ability followed by 26.25 per cent respondents with low level of risk bearing ability and only 6.25 per cent respondents with high level of risk bearing ability. Findings revealed that majority of the respondents (53.75%) had medium level of knowledge on recommended organic cultivation practices of black rice, followed by 30.00 per cent respondents with low level of knowledge and the remaining 16.25 per cent of them were found with high level of knowledge. The findings revealed that majority of the farmers (71.25%) had medium extent of adoption, followed by 23.75 per cent of the respondents having low extent of adoption of recommended organic cultivation practices of black rice. Only 5.00 per cent of them had high extent of adoption of recommended package of practices of organic black rice. Findings of correlation analysis indicated that out of the 19 selected independent variables, 9 independent variables were significantly correlated with farmers' level of knowledge of recommended organic cultivation practices of black rice. Among the 9 independent variables, 8 variables viz., education level (0.841), farming experience as organic black rice cultivator (0.339), extension contact (0.843), mass media exposure (0.477), exposure to training (0.820), scientific orientation (0.328),

decision making ability (0.741) and management orientation (0.829) showed significant and positive relationship with the level of knowledge of recommended cultivation practices of organic black rice at 0.01 level of probability and 1 variable viz., farm mechanization (0.272) showed significant and positive relationship with the level of knowledge of recommended organic cultivation practices of black rice at 0.05 level of probability. The variables which were found to have significant correlation with level of knowledge of recommended cultivation practices of organic black rice were further selected for multiple linear regression analysis with a view to determining the relative influence of those variables in predicting the variation in level of knowledge. The prediction power of multiple regressions was estimated with the help of coefficient of multiple determinations ( $R^2$ ) and adjusted  $R^2$ . Out of 9 independent variables, only 5 variables, viz., education level (0.329), extension contact (0.716), exposure to training (0.155), decision making ability (0.544) and management orientation (0.267) were found to contribute significantly towards variation in the farmers' level of knowledge of recommended organic cultivation practices of black rice. Four variables, viz., extension contact, exposure to training, decision making ability and management orientation showed significant contribution towards level of knowledge at 0.01 level of probability and only one variable viz., education level showed significant contribution towards the level of knowledge of recommended cultivation practices of organic black rice at 0.05 level of probability. The value of  $R^2$  (0.902) indicated that 9 independent variables selected for the study were efficient in predicting the level of knowledge of recommended organic cultivation practices of black rice. The 9 independent variables fitted in the linear regression analysis could predict 90.20 per cent of the variation in the farmers' level of knowledge of recommended organic cultivation practices of black rice. The value of adjusted  $R^2$  (0.890) indicated that 9 independent variables selected for regression analysis could predict 89.00 per cent of the variation in the farmers' level of knowledge of recommended organic cultivation practices of black rice taking only the useful variables into account. Findings of correlation analysis indicated that out of the 20 selected independent variables, 10 independent variables were significantly correlated with extent of adoption of recommended organic cultivation practices of black rice by the farmers. Among the 10 independent variables, 9 variables viz, education level (0.793), size of operational land holding (0.736), extension contact (0.857), mass media exposure (0.859), exposure to training (0.831), scientific orientation (0.781), decision making ability (0.449), achievement motivation (0.548) and economic motivation (0.849) showed significant and positive relationship with the extent of adoption of recommended cultivation practices of organic black rice at 0.01 level of probability and 1 variable viz., knowledge (0.261) showed significant and positive relationship with the extent of adoption of recommended organic cultivation practices of black rice at 0.05 level of probability. The variables which were found to have significant correlation with extent of knowledge of recommended organic cultivation practices of black rice were further selected for multiple linear regression analysis with a view to determining the relative influence of those variables in

predicting the variation in extent of adoption. The prediction power of multiple regressions was estimated with the help of coefficient of multiple determinations ( $R^2$ ) and adjusted  $R^2$

# **Technological Empowerment of Flood Affected Farmers for Sustainable Rice Production in North Bank Plains Zone of Assam**

*Manash Pratim Chetia*

The study entitled 'Technological Empowerment of Flood Affected Farmers for Sustainable Rice Production in North Bank Plains Zone of Assam' was conducted with the following objectives: 1. Assess the nature and extent of damage caused to rice growing farmers on account of flood 2. Study the interventions followed by different agencies to mitigate the damage in the affected rice fields 3. Assess the extent of adoption of recommended post flood rice cultivation practices by the farmers 4. Find out the problems faced by the farmers in adoption of recommended post flood rice cultivation practices The present study was conducted in The North Bank Plains Zone of Assam. The North Bank Plains Zone consists of 6 districts. Out of these 6 districts, the study was undertaken in Lakhimpur and Dhemaji districts of Assam which were selected purposively based on cropped area under flood hazard zone(ha). A proportionate-cumrandom sampling (Proportionate allocation technique) technique was followed for the selection of sub-divisions, blocks and villages. A sample of 160 flood affected rice growing farmers was selected from the 8 selected villages following proportionate allocation technique. The major tool used for collection of primary data in the study was a pretested schedule by personal interview method. The statistical tools used for analysis and interpretation of data included frequency distribution, percentage, mean, standard deviation, coefficient of variation, t-test, and multiple regression analysis. Keeping in view the objectives of the study, 18 variables were included in profile characteristics of the respondents and 2 descriptive variables were included in the study. The descriptive variables included in the study were the nature and extent of damage caused to rice growing farmers on account of flood and extent of adoption of recommended post flood rice cultivation practices which were measured by using structured schedule. Findings revealed that majority of the respondents (50.62%) belonged to middle aged category with higher secondary/ PU level of education (31.87%). Majority of the respondents (59.38%) had large family size with nuclear family type (73.13%). Nearly half of them (49.38%) had medium (16-30 years)

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experience of rice farming and ii majority (65.00%) with only cultivation as their occupation. Majority of the respondents (53.12%) belonged to the marginal category possessing operational land holding up to 1.0 ha and in case of area under rice cultivation, (79.38%) were having land area from 0.3 to 2.0 ha under rice cultivation. Majority of the respondents (74.37%) had medium annual net farm income ranging from Rs. 37,653.84– 1,02,621.19. In case of social participation, majority of the respondents (71.87%) were member of one organization with medium level of scientific orientation (59.38%). Majority of the respondents (52.50%) had medium level of leadership ability with medium level of decision making ability (65.62%). Majority of the respondents (68.12%) had medium level of risk orientation with medium level of achievement motivation (59.38%). Majority of the respondents (65.62%) had medium level of economic motivation. Majority of the respondents (46.88%) had medium level of information exposure and majority of them had high level of exposure to training (48.12%). Based on their frequency level on each category of training exposure viz., No training, 1-day training, 2-day training and 3-day training and above, majority (78.75%) of the respondents attended 1-day training. For determining the nature and extent of damage to rice farmers on account of flood, the damage function was worked out. The regression analysis was worked out with “total damage incurred in rupee” as the dependent variable and soil damage, water damage, crop damage and livestock damage as independent variables. For working out the total damage expenditure incurred (in rupee) for each item in soil, water, crop and livestock, the approximate cost (in rupee) of recovery of respective items was estimated as perceived by the respondent which was taken as damage expenditure for the respective items. The predicting power of multiple regressions was estimated with the help of coefficient of multiple determinations ( $R^2$ ) and adjusted  $R^2$ . Findings of regression analysis revealed that the independent variables were found to have significant positive effect in predicting the dependent variable (total damage incurred in rupees). The value of  $R^2$  (0.8283) indicated that 4 independent variables selected for the study were efficient in predicting the variation in total damage expenditure. The 4 independent variables fitted in the linear regression analysis could predict 82.83 per cent of the variation in total damage expenditure. The value of adjusted  $R^2$  (0.8239) indicated that 4 independent variables selected for regression analysis could predict 82.39 per cent of the variation in damage expenditure in only the useful variables taken into account. When all variable values are zero, the damage expenditure was Rs. 27,948.82. Keeping other variables at constant one unit score increase in soil will increase the damage by Rs. 849.38. One unit score increase in water will increase the iii damage expenditure by Rs. 659.96 keeping other things constant. Keeping all other variables constant, increase in one unit score in crop damage will increase the damage expenditure by Rs 886.64. One unit increase in livestock (standard unit) will increase the damage expenditure by Rs. 22,819.18. The economic damage calculated for one hectare revealed Rs.921.40 for water damage, Rs. 2,991.97 for soil damage, Rs. 2,646.98 for crop damage and for livestock, one unit economic damage varies for different component viz., Rs.17,000.00 for a cow; Rs. 25,000.00 for a bullock;

Rs. 3,900.00 for a young stock; Rs. 2,250.00 for a goat, Rs. 5,400.00 for a pig and Rs 50.00 for poultry. A total of 321 livestock units were lost amounting to a sum of Rs. 18,46,250.00 in total economic damage to livestock. Findings on interventions followed by different agencies to mitigate the damage in the affected rice fields indicated that 14 major activities were included by the different agencies to mitigate the damage in the affected rice fields. Eight agencies which include both Government and Non-Governmental organizations were seen implementing the mitigation activities in the study area. Findings revealed that the majority of the farmers (74.37%) had medium extent of adoption, followed by 19.37 per cent of the respondents having low extent of adoption of recommended package of practices of post flood rice cultivation. Only 6.25 per cent of them had high extent of adoption of recommended package of practices of post flood rice cultivation. Findings revealed that “Non-availability of critical inputs in adequate time and quantity”, followed by “Siltation” and “Inadequate credit facility” were the most important problems faced by the farmers in adoption of recommended post flood rice cultivation practices which were ranked 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> respectively based on Problem Confrontation Index (PCI) scores.

# **Farmers Preference Towards Farm Mechanization-A Study in North Bank Plain Zone of Assam**

*Manjil Baruah*

The present study was carried out with the following objectives: 1. To appraise about the existing farm mechanization status of farmers 2. To assess the preferences of farmers toward mechanization of farm practices and their farm machineries 3. To analyze the factors influencing in the farmers' preference towards mechanization of farm practices. 4. To identify constraints, if any faced by the farmers for farm mechanization. The study was conducted in NBPZ of Assam and for the study descriptive research design was used and a purposive cum random sampling technique was followed for selection of 120 respondents which constituted the sample for the study. The major tool used for collection of primary data in the study was a pretested schedule and personal interview method. The statistical tools used for analysis and interpretation of data were frequency, percentage, mean, standard deviation, weighted mean score, coefficient of variation, multiple regression analysis and chi-square test. The findings revealed that majority of the respondents (59.16%) were in the middle age category (31-55 years) with one-fourth of the respondent's i.e. 25.83% had completed high school level education. One-third of the respondents (33.33%) were small farmers with land holding between 1.00 to 2.00 ha and medium type land for majority of the respondents (45.00%). Agriculture with business or service were the occupation for 54.17% respondents and Average gross annual income was Rs. 1,87,766.66.00. Majority of the respondents had medium level of farming experience (59.17 %) and degree of innovativeness (72.50%). Level of extension contact was found medium level for majority respondents (53.33%) and commercial banks was the sources of credit and highly accessible for majority of respondents. Medium level of mass media exposure and labour availability was reported for 78.33% and 72.50% respectively. Service centres were available in locality for majority (60.00%) of the respondents while more than 70% respondents attended training related to farm mechanization and accessed benefits from 'Rastriya KrishiVikasYojana' scheme. It was observed that majority of the respondents had medium level of farm mechanization (60.83%) and medium level of

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preferences towards farm mechanization (72.50 %). As compared to return and profit cost of machinery is low, high rate of return in limited time, gives more area covered and more work done in limited time frame, very less drudgery compared to draught animals, hiring rate of machinery is quite good were the major causes for farmers to prefer mechanization of farm practices. The preference of farmers towards farm mechanization was correlated with 5 independent variables, viz. gross annual income ( $r=0.731$ ), degree of innovativeness ( $r=0.740$ ), extension contact ( $r=0.526$ ), accessibility of credit ( $r=0.792$ ), and training exposure ( $r=0.735$ ). Out of 5 variables 3 independent variables fitted in the linear regression analysis could predict 85.30% of the variation in preferences of farmers towards farm mechanization. The level of farm mechanization was significantly and positively correlated with six independent variables land holding ( $r=0.212$ ), gross annual income ( $r=0.772$ ), degree of innovativeness ( $r=0.749$ ), extension contact ( $r=0.621$ ), accessibility of credit ( $r=0.782$ ), and training exposure ( $r=0.713$ ). Out of the 6 variables 4 variables contribute 87.7 % ( $R^2 = 0.877$ ) to express the variation of extent of farm mechanization. 'Non availability of suitable type of farm machineries compatible to farmer's agro ecological situation' was the most important constraint faced by 90.83% of the respondents. 'Lack of sufficient own funds to meet initial high costs of farm machinery' was the second most important constraint faced by 88.33% of the respondents. 'Lack of adequate credit facilities and rigid repayment norms' was the third important constraint faced by 80.33% of the respondents. Extensive training and capacity-building programs, establishment of custom hiring centres with all location-specific machineries should be arranged.

## **Role awareness of extension functionaries in facilitating agricultural marketing in Assam**

*Nipam Patowary*

Agriculture remains as the main stay of Indian economy since time immemorial. With food being the crucial need of mankind, much emphasis has been given on facilitating agricultural marketing which involves marketing of food products. Agricultural extension in this present scenario has been recognized as an essential mechanism for delivering knowledge and information. The role of extension functionaries in facilitating marketing is now being emphasized in a big way, be it through FPO/FPCs (Farmers' Producer Organizations/Farmer Producer Company), start-ups, agri-business ventures, agripreneurship, etc. Even though agri. extension focused earlier on (TOT) Transfer of Technology, there is a need to serve as facilitators in agricultural marketing. Hence the present study was done to understand the role awareness of extension functionaries in facilitating agricultural marketing. The present study was conducted in four districts of Assam, viz., Darrang, Barpeta, Goalpara and Kamrup in the year 2021 with three objectives: - 1. To study the socio-personal characteristics of extension functionaries 2. To assess the role awareness of extension functionaries in facilitating agricultural marketing 3. To find out the constraints faced by the extension functionaries in facilitating agricultural marketing The study encompassed 120 respondents in total by using purposive cum random sampling design. Data was collected using personal Interview schedule. Statistical tools and procedures employed to analyze the data were Frequency, Percentage, Mean, Standard deviation, Pearson product moment correlation coefficient, 't' test and Chi-square test. The findings revealed that 60.80 per cent of the respondents belonged to the age group of 34 to 48 years, with majority (63.30 %) being male and most of them (51.70 %) had academic qualification of Master's and above. Majority (46.70 %) had exposure of 4 to 6 training programmes relating to agriculture marketing in their service tenure. 62.50 per cent respondents had service experience between 5 to 14 years. Moreover, it was found that majority (64.20 %, 65.00 %, 60.90 %, 92.50 %) of the respondents had medium level of job involvement, job satisfaction, mass media exposure and cosmopolitaness, respectively, and 53.30 per cent had high level of achievement motivation. The study further revealed that majority (64.20 %) of the extension functionaries had partial level

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of role awareness in facilitating farmers towards agricultural marketing. Constraints faced by extension functionaries in facilitating agricultural marketing included absence of output grading facility, lack of proper supply and services of agricultural inputs, lack of proper technology and insufficient trainings, lack of transportation facilities, adulteration of produce and lack of quality control measures, etc. The findings of the study indicated that by raising the level of role awareness of extension functionaries through proper training, technical support and implementation of certain schemes in the right earnest would provide ample scope for benefit of the farmers in agricultural marketing. Extension functionaries shall have to be sensitized adequately to perceive their role in facilitating farmers in agricultural marketing.

## **A study on utilization of livelihood diversification among small and marginal tribal farmers in North Bank Plains Zone of Assam**

*Prince Gogoi*

The study entitled 'A Study on Utilization of Livelihood Diversification among Small and Marginal Tribal Farmers in North Bank Plains Zone of Assam' was conducted with the following objectives: 1. Assess the extent of utilization of different components of livelihood diversification by the small and marginal tribal farmers 2. Find out the factors influencing the extent of utilization of different components of livelihood diversification by the small and marginal tribal farmers 3. Identify the problems faced by the small and marginal tribal farmers in utilization of livelihood diversification The present study was conducted in The North Bank Plains Zone of Assam. The North Bank Plains Zone consists of 6 districts. Out of these 2 districts were selected randomly viz., Dhemaji and Lakhimpur. A random sampling was followed for the selection of sub-divisions, blocks and villages. A sample of 130 small and marginal tribal farmers was selected from the 8 selected villages following proportionate allocation method. The major tool used for collection of primary data in the study was a pretested schedule by personal interview method. The statistical tools used for analysis and interpretation of data included frequency, percentage, mean, standard deviation, coefficient of variation, t-test, multiple correlation coefficient and multiple regression analysis. The dependent variable included in the study was extent of utilization of different components of livelihood diversification. All together 16 independent variables were included in the study. Findings revealed that majority of the respondents in both the farm size groups belonged to middle aged category with their percentages being 54.54 and 67.92 for marginal and small farmers, respectively. Majority (33.77%) of the marginal farmers had high school level education and majority (30.18%) of the small farmers had high school level of education. Majority of the respondents in both the farm size groups had single but large size family. 59.23 per cent of the respondents were marginal farmers and 40.77 per cent small farmers. Majority of the marginal farmers (59.74%) and (41.51%) of small farmers had only cultivation as occupation. Majority of the marginal farmers (49.35%) and majority (47.17%) of small farmers had membership

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in one organization. Majority (49.35%) of the marginal farmers had low credit seeking behaviour, while majority (56.30%) of the small farmers had medium credit seeking behaviour. Majority of the respondents had medium degree of information exposure, the figures being 71.42 and 73.59 per cent for marginal and small farmers, respectively. Majority of the respondents of both the categories were in medium farm mechanization category, the figures being 70.13 and 73.58 per cent for marginal and small farmers, respectively. Majority of the marginal farmers (40.26%) had low innovativeness while majority (43.40%) per cent of small farmers had medium innovativeness. Majority of the marginal farmers (68.83%) and small farmers (73.58%) had medium level of exposure to training. Majority of the marginal farmers (62.34%) and small farmers (66.04%) had medium scientific orientation. Majority of the respondents of both the categories had low risk orientation, the figures being 53.25 and 58.49 per cent for ii marginal and small farmers, respectively. Similarly, majority of the respondents of all the categories had medium economic motivation, the figures being 55.85 and 54.72 per cent for marginal and small farmers, respectively. Majority of the respondents of all the categories had medium management efficiency, the figures being 64.94 and 67.92 per cent for marginal and small farmers, respectively. In this study, the extent of utilization of different components of livelihood diversification was measured in terms of the practices followed by the farmers to maintain their livelihood by using the Utilization score. A total of 18 components of livelihood diversification followed by the small and marginal tribal farmers was selected for the study. As regards extent of utilization of different components of livelihood diversification, in case of marginal farmers, majority (66.24%) had medium extent of utilization of different components of livelihood diversification and 16.88 per cent of them had low and high extent of utilization of different components of livelihood diversification. In case of small farmers majority of the respondents (64.15%) had medium extent of utilization of different components of livelihood diversification followed by 24.53 per cent of them had low and 11.32 per cent of them had high extent of utilization of different components of livelihood diversification. In the pooled sample of farmers, majority of the respondents (69.23%) had medium extent of utilization of different components of livelihood diversification followed by 16.92 per cent of them had high and 13.85 per cent of them had low extent of utilization of different components of livelihood diversification. Findings of correlation analysis reveal that in case of marginal farmers, 10 independent variables and in case of small farmers, 10 independent variables were significantly correlated with the extent of utilization of different components of livelihood diversification. In respect of pooled sample of farmers, 10 independent variables were significantly correlated with the extent of utilization of different components of livelihood diversification. The findings of regression analysis of extent of utilization of different components of livelihood diversification revealed that, in case of marginal farmers out of 10 independent variables, only 6 variables were found to contribute significantly towards the extent of utilization of different components of livelihood diversification. The variables viz., credit seeking behaviour (0.003), exposure to training (0.004) and



scientific orientation (0.009) all positively and significantly contributed towards extent of utilization of different components of livelihood diversification at 0.01 level whereas the variables viz., degree of information exposure (0.013), social participation (0.025) and management efficiency (0.028) had positive and significant contribution towards extent of utilization of different components of livelihood diversification at 0.05 level. The value of R<sup>2</sup> (0.841) indicated that 10 independent variables selected for regression could predict 84.10 per cent of the variation in extent of utilization of different components of livelihood diversification. The value of adjusted R<sup>2</sup> (0.825) indicated that the independent variables fitted in the regression equation could actually explain 82.50 per cent of the variation in the extent of utilization of different components of livelihood diversification. As regards small farmers out of 10 independent variables, only 5 variables were found to contribute significantly towards the extent of utilization of different components of livelihood diversification. The variable viz., education level (0.001) had positive and significant contribution towards extent of utilization of different components of livelihood diversification at 0.01 level, whereas the variables viz., credit seeking behaviour (0.029), innovativeness (0.021), exposure to training (0.016) and risk orientation (0.047) all positively and significantly contributed towards iii extent of utilization of different components of livelihood diversification at 0.05 level. The value of R<sup>2</sup> (0.834) indicated that 10 independent variables selected for regression could predict 83.40 per cent of the variation in extent of utilization of different components of livelihood diversification. The value of adjusted R<sup>2</sup> (0.816) indicated that the independent variables fitted in the regression equation could actually explain 81.60 per cent of the variation in the extent of utilization of different components of livelihood diversification. In respect of pooled sample of farmers, out of 10 independent variables, only 5 variables were found to contribute significantly towards the extent of utilization of different components of livelihood diversification. The variables viz., social participation (0.008), innovativeness (0.0003) and exposure to training (0.003) all positively and significantly contributed towards extent of utilization of different components of livelihood diversification at 0.01 level, whereas the variables viz., education level (0.024) and economic motivation (0.037) had positive and significant contribution towards extent of utilization of different components of livelihood diversification at 0.05 level. The value of R<sup>2</sup> (0.816) indicated that 10 independent variables selected for regression could predict 81.60 per cent of the variation in extent of utilization of different components of livelihood diversification. The value of adjusted R<sup>2</sup> (0.801) indicated that the independent variables fitted in the regression equation could actually explain 80.10 per cent of the variation in the extent of utilization of different components of livelihood diversification. “Lack of finance to start a new enterprise”, “Lack of easily available credit” and “High cost of labour” were the most important problems faced by the farmers in utilization of livelihood diversification which were ranked 1st, 2nd and 3rd, respectively.

# **A Study on Effectiveness of Self-Help Groups (SHGs) Organized under Assam State Rural Livelihood Mission (ASRLM) in Jorhat District of Assam**

*Rittika Baruah*

Under the Swarnjayanti Gram Swarozgar Yojana (SGSY), SHGs have just evolved into a source of credit for the underprivileged in rural regions, leaving other components like social mobilization, institution, and capacity building. As a result, Swarnjayanti Gram Swarozgar Yojana (SGSY) was transformed into the National Rural Livelihood Mission (NRLM), the most recent programme to address poverty since 2011 and to embrace a “livelihood approach”. In Assam, Assam State Rural Livelihood Mission (ASRLM) is working with less fortunate women of the society. Keeping in view of growing importance of SHGs under ASRLM, the present study on “Effectiveness of self-help groups (SHGs) organized under Assam State Rural Livelihood Mission (ASRLM)” was undertaken in Jorhat district of Assam. Data were collected through personal interview method from 120 respondents during the month of May in 2022. After analysis, it was revealed from the findings that the most members (48.33%) of SHGs belonged to 30-39 year old demographic, were married (95.83%) were high school pass (28.33%), mostly had (72.5%) nuclear family and 2-4 members (57.50%). Most of the members (38.33%) were engaged in animal husbandry as occupation and most of them (43.33%) reared cattle, poultry and goat. Most of the members (39.39%) were influenced by Jeevika Sakhis to join SHGs and most of them (50%) joined SHGs for income generating activities. 84.17 percent did not have membership in any social organizations or institutions. Most of the members (75.83%) had medium change agent contact with ASRLM Staff ranking I with a WMS-4.8. It was revealed from the findings that most members (96.67%) had access to revolving fund (RF), 61.21 percent of members used revolving fund (RF) for increasing standard of living. Most members had access to Community Investment Fund (CIF) (83.33%) and 56 percent members had used Community Investment Fund (CIF) for increasing standard of living. 66.67 percent members had availed internal loan from SHGs and 56.25 percent members had used it for increasing standard of living. Income levels per

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month of members increased in the income group above Rs 2000 and Rs 1501-2000 from 4.17 percent to 15.83 percent and 23.33 percent to 50 percent respectively. The levels of income declined for the income groups, less than Rs 1000 and Rs 1000-1500, from 20.83 percent to 3.33 percent and 51.67 percent to 30.83 percent, respectively. Monthly saving levels of respondents increased for the saving 8 ranges of Rs. 200-500, Rs 501-1000 and above Rs. 1000 from 28.33 percent to 42.50 percent, 5.83 percent to 25 percent and 0.83 percent to 11.67 percent respectively. 35.16 percent had their source of savings in Assam Gramin Vikash Banks, 76.67 percent had medium understanding of various financial activities, 75 percent started their self-employed activity after joining SHGs, 60 percent had invested in existing farm-based activity. 75 percent of members had medium training satisfaction, 82.5 percent had medium level of decision making, 87.5 percent respondents had medium level of self-confidence, 71.67 percent had medium level of managerial skills, 74.16% had medium level of risk-bearing ability, 51.67 percent of members had medium standard of living index (SLI). 89.16 percent had medium level of awareness. Among the problems, absence of group based income generation activities ranked I, insufficient skill based training ranked II, information related to training, loans and other information given by ASRLM staff limited to Jeevika sakhi ranked III, non-availability of inputs and raw material at individual level for personal enterprise ranked IV, lack of mutual understanding among members ranked V, issue with marketing products ranked VI, lack of motivation within the group members of SHGs ranked VII, lack of time to participate in activities due to multiple burden of work in home ranked VIII, lack of support from the family ranked IX and poor monitoring and technical guidance from the officials ranked X.

## **Agar (*Aquilaria malaccensis*) cultivation as a means of livelihood: A study in Golaghat and Sivasagar district of Assam**

*Simanku Pegu*

The present study was carried out in Golaghat and Sivasagar districts of Assam with the objectives to study the personal and socio-economic characteristics of Agar growers in Assam, their livelihood status, to identify the relationship between personal and socio-economic characteristics and livelihood status of Agar growers, and to find out the problems in Agar cultivation as a means of livelihood. A total of 120 Agar growers were selected by following snowball sampling technique. For analysis, appropriate statistical tools viz. frequency, percentage, mean, standard deviation, weighted mean score, correlation coefficient along with multiple regression analysis were used. The findings revealed that majority (46.67%) of the respondents belonged to the age group of 36 to 50 years. Further, 38.33 per cent of the respondents completed high school education, majority (50.83%) of the respondents had a small family and 46.67 per cent of the respondents possessed marginal size of land holdings. Moreover, 68.33 per cent of the respondents had 9 to 28 years of experience in Agar cultivation and majority (55%) of the respondents were involved in cultivation and business as their occupation. 65.83 per cent of the respondents had annual income between Rs. 85160 to Rs. 155857. 62.50 per cent of the respondents were members of one organization. Majority (64.17%) of the respondents had medium extension contact and 66.67 per cent of the respondents belonged to medium category of mass media use. Majority (41.67%) of the respondents had medium market orientation and 70.83 per cent of the respondents had medium economic motivation. Majority (55.83%) of the respondents had medium livelihood status followed by low (22.50%) and medium (21.67%) livelihood status. Age, operational land holding, experience in Agar cultivation, occupational status, annual income, social participation, extension contact and economic motivation were positively correlated with livelihood status. 71.6 per cent variation in livelihood status of Agar growers was due to the independent variables selected for the present study. Age, operational land holding, occupational status, annual income and economic motivation positively and significantly contributed towards livelihood status. Lack of organized market facility (Rank I) was the major problem in Agar cultivation followed by lack of

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trainings/demonstrations provided (Rank II), lack of support from line departments (Rank III), lack of knowledge on grading of Agar (Rank IV), lack of regulated price for Agar (Rank V), exploitation by middlemen (Rank VI), weak market linkage (Rank VII), inadequate knowledge about artificial induction in Agar and problems in transportation (Rank VIII), lack of research-extension linkage with growers (Rank IX), high initial capital requirement (Rank X), inadequate knowledge about symptoms of pest and diseases and lack of proper policy regarding transportation and sale (Rank XI), lack of assured financial support (Rank XII), inadequate technical knowledge about fertilizers and pesticides (Rank XIII), lack of nursery for seedlings (Rank XIV) and high wages of skilled labour ranked XV respectively

# **A Study on the Organizational Culture and Employees' Mental Health Status of Assam Agricultural University, Jorhat**

*Sugantha A P*

The Present study was conducted in Jorhat campus of Assam Agricultural University with sample size of 300 non-teaching employees of two categories viz. regular and contractual. 14 Independent variables, 2 dependent variables and one descriptive variable were selected. The main objectives of this study is to study the mental health status of AAU employees, to determine the factors affecting organizational culture of AAU and to identify the problems faced by employees of AAU and to pull the Suggestions thereof. The collected data were analysed using the statistical tools like Pearson's correlation, t-test and factor analysis. The findings show that the majority of the respondents (51.3%) mental health was good and it has a significant relationship with Job satisfaction and Organizational culture of AAU at 0.01 level of significance. It was also found that the majority of the employees had no exposure (73.33%) to training program, 76.66% of employees were moderately satisfied with their job, 69.33% had fair role performance and 79.33% of employees had shown moderately favourable attitude towards their work. Majority of the response (78.66%) has proved that AAU has moderate organizational culture and it was found significant with job Satisfaction, and mental health status of the employees at 0.01 level of significance and Attitude of employees towards organization culture at 0.05 level of significance. The result of factor analysis revealed that the lack of technical skill is the principal problem faced by AAU employees. The study suggests that there is a necessity to conduct need based training programs to the employees, the authority should emphasis on the significant factors and there should be a conscious efforts to make the Organizational culture more friendly and people-oriented. Awareness about Kiran 24/7 helpline and access to employee assistance program also could be done.

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# **Impact Assessment of Assam State Rural Livelihoods Mission (ASRLM) in Providing Livelihood Security to Farm Women in Golaghat District of Assam**

*Susmita Phukan*

The Assam State Rural Livelihoods Mission (ASRLM) society implemented the centrally sponsored scheme Deendayal Antyodaya Yojana National Rural Livelihood Mission (DAY-NRLM) in Assam from the year 2011 for elimination of rural poverty through multiple livelihoods. The goal of ASRLM is poverty elimination through organizing and building strong institutions of poor (women), enabling them to access financial resources at affordable terms, and, to have a portfolio of sustainable livelihoods. The present study entitled ‘\_Impact of Assam State Rural Livelihoods Mission (ASRLM) in providing livelihood security to farm women in Golaghat district of Assam’ was conducted to find out how much impact the project has been able to create among the farm women. Data pertaining to the study were collected through personal interview method during the period of January, 2022 to June, 2022. A purposive cum proportionate random sampling method was followed for the study. The total sample size was 120 consisting of 84 beneficiaries and 36 non-beneficiaries farm women in the study area. For the present study a total of 25 variables were selected. Both qualitative and quantitative data were collected. Appropriate statistical techniques were used for analysis of data. The findings with respect to the selected profile characteristics of the respondents indicated that the Majority of beneficiaries (44.05%) and non-beneficiaries (41.67%) were between the ages of 40 and 50; 26.19 per cent of beneficiaries had completed high school, while 30.56 per cent of non-beneficiaries had only completed below primary level education. It was revealed from the findings that there was no significant difference between the family size (2-4 members), caste (OBC), marital status (married), size of operational land holding( marginal farmers) of the beneficiaries and non-beneficiary farm women respondents. The major occupation of 45.23 per cent of beneficiaries was (Agriculture+ Animal husbandry) followed by 30.95 per cent in (Agriculture+ Small scale business); while 50 per cent of the non-beneficiaries were only engaged in agriculture as their major occupation. Around 55.95

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per cent of the beneficiaries had job cards but only 44.44 per cent of the non-beneficiaries had job cards. In case of social participation, extension contact, livestock possession, mass media use pattern, not much difference could be observed between the beneficiary and non-beneficiary respondents. 76.19 per cent of beneficiaries and 38.88 per cent of nonbeneficiaries reported having medium extension contact, while the majority of 7 respondents (63.10% of beneficiaries and 75% of non-beneficiaries) did not belong to any other organisations than the ASRLM SHG. The majority of respondents (70.23% of beneficiaries and 58.33% of non-beneficiaries) had medium range use of mass media contact, while 28.57 per cent of beneficiaries and 25 per cent of non-beneficiaries possessed cattle, poultry, and goats. The beneficiaries (30.05%) were mostly selfmotivated to join Self Help Groups (SHGs) and in the case of non-beneficiaries, friends (30.56%) had the influence on them to join the SHGs. The reason for joining the SHGs for both the beneficiaries and non-beneficiaries was mostly economic independence and second reason was for promoting saving habit. In case of psychological, social and economic impact both the beneficiaries and non-beneficiaries have medium impact but the means of beneficiaries were 20.06, 33.05 and 23.88 respectively and for non-beneficiaries 10.44, 22.61 and 16.03 respectively. Around 83.33 per cent of beneficiaries and only 19.44 per cent of non-beneficiaries were able to create new asset .The new assets created by the beneficiaries were mostly (44.05%) new farm activities and 28.57 per cent were enterprises, while 80.56 per cent of the non-beneficiaries had created asset in existing farm activities. The assets created were mostly livestock for both the category of respondents. It was found that mean duration of availing the asset for the beneficiaries were 4 years whereas for the non-beneficiaries were 5.66 years. Around 71.43 per cent of the beneficiaries and only 36.11 per cent of non-beneficiaries were able to maintain the asset. There was change in possession of house from bricks with tin to concrete houses for the majority of the beneficiaries, while majority of the non-beneficiaries had changed from bricks with tin house to bricks with slab houses. 100 per cent of the beneficiaries were able to receive financial assistance under ASRLM whereas only 72.22 per cent of non-beneficiaries were able to receive financial assistance under different schemes. The beneficiaries mostly (73.81%) used the loan for productive assets like creation of livestock, small scale business while 73.07 per cent of the nonbeneficiaries used the loan for non productive assets like personal reasons. As a result of this, 71.43per cent of the beneficiaries and only 26.92 per cent of non-beneficiaries were able to repay the loan in time. 58.33 per cent of the beneficiaries responded that they were aware about employment opportunities but only 11.11 per cent of nonbeneficiaries were aware about the same. Majority of both the beneficiaries and nonbeneficiaries fall in the medium category for increase in capabilities and coping abilities but the mean score of beneficiaries was 23.1 which is higher than 19.11,the mean score 8 of non-beneficiaries. It was discovered that 64.29 per cent of beneficiaries and 38.88 per cent of non-beneficiaries were able to contact state agencies, 70.24 per cent of beneficiaries and 38.88 per cent of non-beneficiaries agreed to an increase in financial literacy, and 77.38 per cent of beneficiaries and 38.88 per cent of non-



beneficiaries could calculate pros and cons before doing anything new individually or in groups after ASRLM intervention to withstand risk, 78.57 per cent and 41.67 per cent of beneficiaries and non-beneficiaries, respectively, believed that ASRLM assisted them in obtaining community support during a crisis. 53.57 per cent of beneficiaries and 38.88 per cent of non-beneficiaries had access to common property resources, whereas 41.67 per cent of beneficiaries and 50 per cent of non-beneficiaries did not. Under ASRLM, 70.24 per cent of beneficiaries and 41.67 per cent of non-beneficiaries had the potential to provide financial support to neighbours in times of distress, and 75 per cent of beneficiaries and 50 per cent of non-beneficiaries had the opportunity to develop leadership qualities. In the dimension of sustainable agriculture under ASRLM, since it has been recently given emphasis along with increasing livelihood security, more involvement of time and resources is required. It was found that while 85.71 per cent of beneficiaries and 22.22 per cent of non-beneficiaries were aware of ASRLM's role in the formation of producer groups, only 14.29 per cent of beneficiaries and none of the non-beneficiaries were members of those groups or had received financial support from them. ASRLM assisted around 85.71 per cent of beneficiaries and 22.22 cent of nonbeneficiaries in developing strategies for minimizing harvest and post-harvest losses, 84.52 per cent and 5.56 per cent of non-beneficiaries in improving their skill and capability in agriculture to support farm-based activities, 23.81 per cent of beneficiaries and 8.33 per cent of non-beneficiaries agreed that drudgery had been decreased, and approximately 95.24 per cent and 100 per cent of beneficiaries and non-beneficiaries, respectively, were not having access to warehouse and storage facility. 77.38 per cent of beneficiaries and 69.44 per cent of non-beneficiaries, respectively, were aware of the importance of eating a balanced diet. The majority (85.71%) of beneficiaries and 50 per cent of non-beneficiaries had a kitchen garden at their residence. 69.05 per cent of beneficiaries received assistance from Jeevika sakhis in planning their kitchen gardens. Around 50 per cent of beneficiaries and no non-beneficiaries received technical advice on intercultural operations from Krishi Sakhis. There has been sufficient change in saving pattern of the beneficiaries but not that in case of the non-beneficiaries. It was observed that majority (60.71%) of 9 the beneficiaries and 72.22 per cent of the non-beneficiaries had only home saving before but now the majority of the beneficiaries (57.14 %) have bank saving+ home saving and 25 per cent save money in insurance + bank saving .This could not be observed in case of non-beneficiaries as 47.22 per cent of them still opted for home saving and only 25 per cent of the non-beneficiaries had bank saving+ home saving. Majority (58.33%) of the beneficiaries had savings level of less than 200 and 27.38 per cent of the beneficiaries had 200-500 savings per month before joining ASRLM. Now after the intervention of ASRLM, 46.43 per cent and 19.05 per cent of the beneficiaries have saving levels of ` (200-500) and ` (501-1000) per month respectively. Earlier, 61.11 per cent of the non-beneficiaries had saving less than ` 200 and 22.22 per cent had savings of ` (200-500) monthly. Now, still the majority percentage of 52.78 per cent of non-beneficiaries has savings less than ` 200 and 27.78 per cent have savings of ` (200- 500) per month. In the t-test for savings and income, it

was observed that before the ASRLM intervention there was no significant difference between the beneficiaries and non-beneficiaries but after the intervention significant difference could be observed. The percentage of change in income is higher in the case of the beneficiaries than the non-beneficiaries, despite the fact that both beneficiaries and non-beneficiaries total incomes increased as a result of the ASRLM intervention. After measuring the standard of living index, it was observed that 61.9 per cent of beneficiaries and 66.66 per cent of non-beneficiaries belonged to medium SLI. While in the high SLI, 32.14 per cent of beneficiaries and 22.22 per cent of nonbeneficiaries were obtained from the analysis. Thus, the programme has been able to bring some changes in the SLI from low to high in case of beneficiaries. Further implications should be taken to bring the 5.95 per cent of the low SLI beneficiaries to the medium or high SLI range. According to the study, the biggest issues faced by farm women were insufficient need-based training, followed by lack of financial support from ASRLM in productive assets, a greater involvement of ASRLM beneficiaries in non-marketing activities, a lack of information transfer about various livelihood and employment programmes by Jeevika Sakhis, and refusal by the Self-Help Group to start a groupbased enterprise. 10 The ASRLM has been successful in significantly enhancing the farm women's standard of living in a variety of ways. However, there is still a lot of discussion over how empowered rural women are in India. It is concluded as a result that strategies need to be created for enhancing programmes meant to support the overall and integrated development of farm women in the research areas.

## **Adoption of Maize Based Cropping System in Flood Affected Areas as Coping Mechanism - A Study in Morigaon District, Assam**

*Swapnali Goswami*

Maize is now being important crop component for cropping system followed in flood affected areas of Assam. Considering the importance of maize crop in flood affected areas, the present study was carried out in Morigaon district of Assam with following objectives - 1. study the extent of adoption of maize based cropping system in flood affected area, 2. assess the income of the farmers after adopting this maize based cropping system, 3. determine perceived effectiveness of maize based cropping system as coping mechanism for flood, 4. study the factors likely to influence in adoption, income and perceived effectiveness of maize based cropping system and 5. identify problems faced by farmers in adoption of maize based cropping system. A purposive and proportionate random sampling method was used for selecting respondents. Appropriate statistical methods were used for analysis and interpretation of data. It was revealed from the study that majority (76%) of the farmers show moderate level adoption of recommended maize cultivation practices. 'Sowing time', 'method of sowing', 'drainage facility and moisture maintain at critical stage' were adopted by all respondents as recommended. While in case of varieties, weeding operation, fertilizer application, plant protection measures were adopted with modification from the recommendation. Different maize based cropping systems were identified in the study area, among which 'Maize-Maize/MustardVegetable' and 'Rice/Maize-Maize/Boro paddy-Jute/Vegetable' cropping systems were mostly followed by the farmers. It was also found from the study that maize varieties such as P3401, DE222, Maharaja 92, Bumper and Sun Vamman were mostly grown in the research area. Maize based cropping system was found more profitable than rice based cropping system. The average income earned by the maize farmers was found as Rs. 3, 35,823 whereas the average income of rice farmers was Rs. 2, 92,649 and difference was found statistical significant. Majority (64%) of farmers following maize based cropping system was found as medium level effectiveness for coping with adverse effect of flood. Well established marketing channel, suitable climate and soil for growing maize and also a

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good benefit cost ratio of maize based cropping system were the important dimensions for farmers to consider it as effective. The result depicts that the explanatory variables 'farming experience' (X4), 'maize cultivated area' (X6), 'cropping intensity' (X8), 'resource status' (X9), 'economic motivation' (X15), 'degree of innovativeness' (X16), 'perceived effectiveness' (X18) and 'income' (X19) were found positive and 'age' (X1), 'operational land holding' (X5), 'flood proneness' (X7) were negative and significantly contributing for expressing the variation of extent of adoption. These variables together explained 87% ( $R^2 = .878$ ) variation of extent of adoption of maize based cropping system. The positive and significant contribution for explaining the variation in income of farmers were 'educational experience' (X2), 'family size' (X3), 'operational land holding' (X5), 'maize cultivated area' (X6), 'cropping intensity' (X8), 'extent of adoption' (X18), 'perceived effectiveness' (X19) and negative and significant contribution for explaining the variation in income of farmers was 'market agent visit to a farm' (X13). These variables together explained 84% ( $R^2 = .848$ ) variation of income of farmers followed maize based cropping system. Likewise positive and significant contribution for explaining the variation in perceived effectiveness of farmers were 'maize cultivated area' (X6), 'resource status' (X9), 'farmers visit to the market' (X12), 'extent of adoption' (X18), 'income' (X19) and 'flood proneness' (X7) was found as negative and significant contribution for explaining the variation in perceived effectiveness. Around 69% variation of perceived effectiveness is explained by these variables in together. But different problems related to finance, market, production etc were also came into focused during the time of personal interview with the respondents. Extension agencies, both private and public extension system need to be strong for understanding the farmers' level problem and try to solve them. There is also a need of different trainings on maize crop and extension system should put forward its sincere efforts for popularizing the benefits of maize crops among the farmers for its further adoption in future.

# **Perception of Farmers on High Yielding Varieties of Rice Released by Assam Agricultural University- A Study in Golaghat District of Assam**

*Varna Murali*

The present study was conducted in Golaghat district of Assam with the objectives to determine the perception of farmers towards AAU released high yielding varieties of rice and its correlation between the selected profile characteristic of the respondents and the problems faced by the farmers in cultivating HYVs of rice along with their suggestive measures. A multistage purposive cum random sampling design was followed for selecting 120 respondents for the study. Appropriate statistical tools viz. frequency, percentage, arithmetic mean, standard deviation, ranking, Pearson's correlation, and chi-square were used to analyze and interpret the data according to the objectives. The analysis of the profile characteristics of the farmers revealed that the majority (70.83 %) of the respondents belonged to the age group of 30 to 50 years and most of them (94.17%) were male, had high school education i.e., 9 to 10 years of formal educational experience, belonged to OBC category (50.83 %), with a medium sized family of 5 to 6 members (55.83 %), Agriculture was primary source of income for the majority (83.33%) with average annual income of ₹ 110437.50. Marginal landholders (less than 1 ha) were the majority (60.00%) in the study area with 80 to 100 per cent of the total operational landholding under rice cultivation with least scatteredness of land holdings. The average farming experience of the respondents was 26.57 years with an average cropping intensity of 147.32 per cent. A major proportion of the respondents (58.33%) had a medium level of innovativeness, degree of commercialization (81.67%), economic motivation (63.33%), extension contact (70.00%), and mass media exposure (70.83%) with the highest extension contact with farmers' organizations and television was the highest utilized mass media. Irrigation facility was not available for the majority (79.17%) of the respondents. Most of them were having a medium degree of farm mechanization, a medium level of labour availability (6-12 number of labour), and a medium level of infrastructural facilities. Around 83.33 per cent of the total rice acreage (90.00 ha) in Sali season was occupied by HYVs of rice released by AAU. The dominating varieties in the study area were

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Ranjit, Ranjit Sub-1, Mahsuri and Bahadur Sub-1 in terms of percentage share of area and percentage adopters. The majority of the farmers had a moderate level of perception on quality of high yielding varieties of rice released by AAU. Greater productivity, climatic adaptability and good cooking quality and taste were the quality traits highly perceived by the farmers. Bina Dhan-11, Keteki Joha, and Ranjit Sub-1 were the varieties perceived as high by the farmers in terms of quality dimensions. Annual income, caste, occupation, degree of land scatteredness, innovativeness, commercialization, economic motivation, extension contact, mass media exposure, the status of infrastructural facilities and family labour were found to have a significant association on perception level of farmers towards HYVs of rice. Fluctuating market price, uncertainty in rainfall, high cost of inputs, lack of irrigation, etc. were some of the severe problems faced by the farmers of the study area in the cultivation of HYVs of rice. It is discovered from the study that the majority of people have a moderate perception on quality dimension of HYVs of rice released by AAU. To popularize the highly perceived high yielding varieties, the extension system should put sincere efforts for promotions through large-scale demonstrations, training, awareness programmes, etc. The varieties having a low level of perception need to be refined and recast quality.

## **Evaluation of Capacity Building Programmes Organised by Sametiassam Vis-A-Vis Requirement of Extension Functionaries**

*Yerra Lahari*

The present investigation conducted to evaluate SAMETI-Assam was carried out with 120 extension functionaries who took training in it during 2018-2021. There were 9 independent, 2 dependent and 1 descriptive variable that were selected. The main Objectives of the study included: to study the socio personal characteristics, to identify the training needs extension functionaries trained by SAMETI-Assam and to evaluate the capacity building programmes organized by SAMETI-Assam and to assess their training effectiveness. The collected data were analyzed using the statistical tools like frequency, percentage, mean, standard deviation, rank, weighted mean score, Karl Pearson product moment correlation coefficient and Chi-square test. The findings revealed that majority of extension functionaries (61.67%) were middle age group and majority of them were male (64.17%). Most of them (50.83%) had academic qualification of Master's degree/Equivalent and (27.50%) had exposure of less than 2 training programmes in their service tenure and 55.84 per cent respondents had service experience is less than 5 years. Moreover, it was found that majority (70.8%, 80.80% and 69.20%) of the respondents had moderate level of job satisfaction, achievement motivation and Scientific orientation. The study further revealed that majority (75.80%) of the respondents found a moderate level of training effectiveness of the training programmes they attended, nearly half (46.67%) of the respondents felt that they "somewhat fulfilled the stated training objectives" and a majority of respondents (40.83%) gave a "Good" rating for training programs they attended. With respect to training needs, it was found that 'use of Mobile Applications', 'connecting farmers with markets', 'FIG's Formation', 'Use and Principles of PRA tools', 'Team Building', 'Awareness about IPR and farmer's rights', 'Identification of training thrust areas', 'Development of groups based on commodities' were the major areas in which the extension functionaries expressed the training needs in future. Besides, "delay in the disbursement of TA", "long distance from the place of posting to the institute", "irregular water supply in the trainee's hostel", "poor Sanitation at the place of

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accommodation” were prime constraints encountered by the extension functionaries while attending training programme in SAMETI-Assam. Key words: Extension functionaries, Capacity Building Programmes, Evaluation, Training needs, constraints.



## **Supplementation of Nitrogenous Nutrient through organic sources in French Bean (*Phaseolus vulgaris* L.)**

*Anupendra Narayan Deb*

An experiment titled “Supplementation of nitrogenous nutrient through organic sources in French bean (*Phaseolus vulgaris* L.)” was conducted in the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat during 2018-19 and 2019-20 with the objective to study the effect of supplementing nitrogenous requirements with vermicompost, FYM and bio-fertilizer on plant growth and marketable fruit yield. The experiment was laid out with fifteen treatments in Randomized Block Design (RBD) with three replications. The treatments were 100% NPK (30:40:20 kg NPK ha<sup>-1</sup>) through inorganic source (T1), 75% NPK through inorganic source + 25% N through FYM (T2), 75% NPK through inorganic source + 25% N through Vermicompost (T3), 50% NPK through inorganic source + 50% N through FYM (T4), 50% NPK through inorganic source + 50% N through Vermicompost (T5), 25% NPK through inorganic source + 75% N through FYM (T6), 25% NPK through inorganic source + 75% N through Vermicompost (T7), T2 + Consortia (T8), T3 + Consortia (T9), T4 + Consortia (T10), T5 + Consortia (T11), T6 + Consortia (T12), T7 + Consortia (T13), 20 t FYM + 30:40:20 kg NPK ha<sup>-1</sup> (T14), untreated control (T15). The treatments had significant influence on growth and yield attributing characters of French bean var. Falguni. Pooled analysis of the data revealed that with the increase in organic supplements the vegetative and fruit yield parameters exhibited an increasing trend, and addition of microbial consortia improved that further. Application of 50% NPK through inorganic source + 50% N through FYM fortified with consortia (T10) recorded the highest marketable fruit yield (136.48 q ha<sup>-1</sup>), closely followed by T13 (135.84 q ha<sup>-1</sup>) and T12 (134.78 q ha<sup>-1</sup>) because of greater number of bolder pods and higher fruit yield per plant. Soil parameters showed significant difference among the treatments. The maximum N, P and K (279.86, 50.54 and 119.94 kg ha<sup>-1</sup>, respectively) content after harvest was available in T8. Although the recommended dose of 20 t FYM + 30:40:20 kg NPK ha<sup>-1</sup> (T14) outperformed other treatments in all parameters, the maximum benefit : cost ratio of 4.27 was obtained in

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T10, followed by 4.22 in T8 (75% NPK through inorganic source + 25% N through FYM + consortia) owing to lower cost of production. Untreated control (T15) registered a minimum fruit yield (68.13 q ha<sup>-1</sup>) and the lowest B: C ratio of 0.70. From the present investigation, it can be concluded that 50% inorganic NPK + 50% N through FYM fortified with consortia is the most remunerative nutritional management for sustainable French bean production, 75% inorganic NPK + 25% N through FYM + consortia is the next best option.

## **Standardisation of stem cutting technique of Dragon Fruit (*Hylocereus costaricensis* Britton & Rose)**

*Anurag Borchetia*

An experiment on “Standardisation of stem cutting technique of Dragon Fruit (*Hylocereus costaricensis* Britton & Rose)” was conducted in the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat during 2020 and 2021 to standardise suitable size and time of cutting with optimum concentration of IBA in Dragon fruit. One year old dragon fruit segments (stem) were collected from the Farm of Krishi Vigyan Kendra, Jorhat. The experiment was laid out in a three factorial Completely Randomised Design with three replications. The treatments were: two time of cuttings – January (M1) and April(M2); three sizes of cuttings – 10 cm(L1), 15 cm(L2), 20 cm(L3); four IBA concentrations –100 ppm(I1), 250 ppm(I2), 500 pm(I3) and 0 ppm(I4). There were twenty-four treatment combinations in the trial. The cuttings were raised in polybags (20 cm x 22 cm). Observations on root and shoot growth, shoot quality parameters were recorded at 40 and 60 days after planting (DAP). Between the January and April month cuttings, the cuttings taken in the month of April gave better performance in terms of root and shoot growth parameters. April cuttings recorded minimum days required for root formation (18.09 days) and shoot initiation (33.44 days) with 98.13% survival. Among the three sizes of cuttings, the 20 cm cuttings exhibited superior root and shoot growth parameters. The 20 cm cuttings recorded early root formation (18.46 days), shoot initiation (29.58 days) and 99.17% survival. Cuttings treated with 250 ppm IBA professed better root and shoot growth parameters among the four IBA concentrations. The 250 ppm IBA treated cuttings recorded maximum root number (13.97 at 40 DAP; 15.97 at 60 DAP), shoot number (3.18 and 5.01 at 40 DAP and 60 DAP respectively), early shoot initiation (29.44 days) and highest survival percentage (99.17 %). The 500 ppm IBA treated cuttings recorded early root formation (15.06 days) and highest length of the longest root (14 cm at 40 DAP; 17 cm at 60 DAP) which was at par with 250 ppm IBA treated cuttings. Among the treatment combinations, T22 (April cuttings+ 20 cm size + 250 ppm IBA) took minimum days for root formation (days) and shoot initiation (days) recorded the highest root number

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(18.84 at 40 DAP ; 20.83 at 60 DAP), root length (18.83 cm at 40 DAP ; 20.83 cm at 60 DAP), root dry weight (0.50 g at 40 DAP ; 0.71 g at 60 DAP) and shoot numbers (4.4 and 5.73 at 40 DAP and 60 DAP respectively), length of primary shoots (21.37 cm at 40 DAP ; 22.7 cm at 60 DAP), shoot dry weight (11.93 and 13.43 g at 40 DAP and 60 DAP respectively), nitrogen percentage (2.71 and 2.75 % at 40 DAP and 60 DAP respectively), protein percentage (16.94 and 17.18 % at 40 DAP and 60 DAP respectively), chlorophyll content (0.45 and 0.51 mg/g at 40 DAP and 60 DAP respectively) and vascular cambium thickness (0.12 and 0.15 mm at 40 DAP and 60 DAP respectively) which was followed by T23 (April cuttings+ 20 cm size + 500 ppm IBA). Thus, it may be inferred that 20 cm cuttings of dragon fruit taken in the month of April treated with 250 ppm IBA appeared to be the best treatment combination which registered minimum days required for root formation and shoot initiation, highest root and shoot growth parameters, shoot nitrogen, protein, chlorophyll content and thickest vascular cambium layer with 100% survival.

## **Integrated nutrient management in dolichos bean (*Lablab purpureus*)**

*Anshunam Tomar*

An experiment entitled “Integrated nutrient management in dolichos bean (*Lablab purpureus*)” was conducted during the months of June-October 2020, at the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat-13 with the objective to study the effect of integrated nutrient management on growth, yield, and quality of dolichos bean and the assessment of soil chemical and biological properties under integrated nutrient management. The experiment was laid out in Randomized Block Design with seven treatments which were replicated three times. The treatments were T1: RDF (30: 40: 20 kg ha<sup>-1</sup> NPK) + FYM @ 10 t ha<sup>-1</sup>, T2: 50 % RD of NPK + Microbial consortium as seed coat + Vermicompost @ 1 t ha<sup>-1</sup>, T3: 25 % RD of NPK + Microbial consortium as seed coat + Vermicompost @ 2 t ha<sup>-1</sup>, T4: 50 % RD of NPK + Enriched Vermicompost @ 1 t ha<sup>-1</sup>, T5: 25 % RD of NPK + Enriched Vermicompost @ 2 t ha<sup>-1</sup>, T6: 50 % RD of N, P, K + Microbial consortium as seed coat + FYM @ 5 t ha<sup>-1</sup>, T7: 25% RD of NPK + Microbial consortium as seed coat + FYM @ 10 t ha<sup>-1</sup>. The integrated utilization of different nutrient sources contributed significantly towards the growth, yield and yield attributing characters like plant height, number of leaves, leaf area index, number of branches, days to first flowering and fruiting, chlorophyll content, number of pods, weight of pods, number of seeds per plant and harvest index, which ultimately contributed towards highest pod yield per plant and per hectare. INM approach improved soil chemical and biological properties significantly by increasing soil available N, P, K, organic carbon, microbial population, soil enzymes activity and soil microbial biomass carbon. The results revealed that the maximum plant height (85.20 cm), number of branches (8.27), number of leaves (60.67), leaf area index (7.60), total chlorophyll content (2.30 mg g<sup>-1</sup> leaf tissue) were observed in treatment T2 (50 % RD of NPK + Microbial consortium as seed coat + Vermicompost @ 1 t ha<sup>-1</sup>). The minimum days for first flowering (40.13) and first fruiting (44.13) were observed in T2. The pod width (1.54 cm) and pod weight (4.22 cm) were found highest in treatment T4 (50 % RD of NPK + Enriched Vermicompost @ 1 t ha<sup>-1</sup>). The results revealed that the maximum number of pods (45.47), pod length (8.11 cm), seeds per plant (237.00), pod yield per plant (187.08 g plant<sup>-1</sup>), pod yield per

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ha (10.33 t ha<sup>-1</sup>) and harvest index (37.26) were found highest in T2(50 % RD of NPK + Microbial consortium as seed coat + Vermicompost @ 1 t ha<sup>-1</sup>). Among the quality parameters, maximum carbohydrate (5.21 g) was obtained in T3 (25 % RD of NPK + Microbial consortium as seed coat + Vermicompost @ 2 t ha<sup>-1</sup>) while highest crude protein was observed in T2 (3.96 %). However, the crude fibre content (1.89 %) was found to be highest in T1 (RDF (30: 40: 20 kg ha<sup>-1</sup> NPK) + FYM @ 10 t ha<sup>-1</sup>). The effect of different treatments on the moisture content of pods was not found significant. The results revealed that the maximum available nitrogen (372 kg ha<sup>-1</sup>), phosphorus (47.13 kg ha<sup>-1</sup>), potassium (184.67 kg ha<sup>-1</sup>) in T5 (25 % RD of NPK + Enriched Vermicompost @ 2 t ha<sup>-1</sup>) and organic carbon (0.98 %) found highest in T7 and T5. Results showed that highest soil microbial biomass carbon (240 µg g<sup>-1</sup> 24hr<sup>-1</sup>), dehydrogenase activity (122.20 µg TPF g<sup>-1</sup> soil 24 hr<sup>-1</sup>), phosphomonoesterase activity (50.90 µg p-nitrophenol g<sup>-1</sup> soil hr<sup>-1</sup>) and microbial population i.e bacteria count (15.71 × 10<sup>5</sup> cfu's g<sup>-1</sup> soil), fungi count (6.84 × 10<sup>3</sup> cfu's g<sup>-1</sup> soil) observed in T5 (25 % RD of NPK + Enriched Vermicompost @ 2 t ha<sup>-1</sup>). Among the different treatments, T2 (50% RD of NPK + Microbial consortium as seed coat + Vermicompost @ 1 t ha<sup>-1</sup>) was found best in terms of growth, yield and quality attributes of dolichos bean. The economic benefit was found to be highest in T2. The T4 (50% RD of + Enriched Vermicompost @1t ha<sup>-1</sup> ) is also notable for its beneficial effect on quality of dolichos bean pods and soil health.

## **Effect of time of planting and PCPA on off season production of Cherry Tomato [*Solanum lycopersicum* (L) var. *cerasiforme* Mill]**

*Anusmita Neog*

An experiment entitled “Effect of time of planting and PCPA on off season production of Cherry Tomato [*Solanum lycopersicum* (L) var. *cerasiforme* Mill]” was conducted during the months of November-June 2018-19, at the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat with the objective to assess the standard concentration of PCPA along with standardization of planting time of Cherry Tomato for off-season cultivation under greenhouse condition. The experiment was laid out in a Randomized Block Design with four treatments which were replicated three times. The different planting times were A<sub>1</sub>: 26/11/2018, A<sub>2</sub>: 26/02/2019, A<sub>3</sub>: 26/03/2019 and A<sub>4</sub>: 26/04/2019. The hormonal treatments were B<sub>1</sub>: Control, B<sub>2</sub>: 50ppm of PCPA, B<sub>3</sub>: 75ppm of PCPA and B<sub>4</sub>: 100ppm of PCPA.

The application of 75ppm PCPA on cherry tomato plants grown during the month of November, applied in flowers at an interval of 15 days contributed significantly towards increasing the yield and yield attributing characters like flowering clusters per plant, flowers per cluster, fruiting clusters per plant, fruits per cluster, weight and volume of the fruit, fruit set, number of fruits per plant which ultimately contributed towards highest fruit yield per plot as well as per 1000m<sup>2</sup>. The results revealed that the growth and development characters like plant height, number of branches were also significantly higher in 50ppm PCPA and 75ppm PCPA grown during the month of November. The number of seeds per fruit was reduced with increasing concentration of PCPA and planting date. Pericarp thickness, calyx length was found to be non-significant.

The quality characters of the fruits showed significant variation among the treatments. 75ppm PCPA gave the highest TSS, Titratable acidity, Ascorbic Acid and Total sugar. The highest juice percent, Ascorbic Acid and Total sugar was shown by plants grown during the month of November. Whereas the maximum Titratable acidity and TSS was shown by plants grown during the month of March.

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**Major Adviser: Dr. Deepa Borbora Phookan**

The physiological results showed the maximum pollen viability and Chlorophyll content along with total biomass of the plants with treatments of 100ppm PCPA, 75ppm PCPA and 50ppm PCPA. The lowest values for these parameters were shown by control plants. Among the different planting times the maximum for these values were shown by plants grown during November month of planting followed by February month of planting.

The maximum B:C ratio was obtained in plants grown during the month of February with 100ppm PCPA. And the minimum (-0.54) was obtained in control plants during the month of March.

From the present study it can be suggested that, application of 75ppm PCPA in cherry tomato plants grown during the month of November can be beneficial towards improving the yield and yield attributing characters. Due to higher market price fetched by the crop during the off-season availability it was seen that with application of 100ppm PCPA during February planting contributed to maximum profit though the plants showed reduced yield in this month planting. Whereas more of other growth characteristics were found to be better with application of 50ppm PCPA and also planting date extended till February.



## **Chemical and spectroscopic estimation of Kolakhar produced from parts of different Banana cultivars**

*Aradhana Bordoloi*

An experiment on “Chemical and spectroscopic estimation of Kolakhar produced from parts of different banana cultivars” was conducted during 2019-2021 in the laboratory, Department of Horticulture, Biswanath College of Agriculture, AAU, Biswanath Chariali with two objectives (i) to estimate the chemical and mineral constituents of Kolakhar produced from rhizomes and peels of different banana cultivars, and ii) to identify the cultivar suitable for preparation of Kolakhar. Four cultivars with different genomic groups selected for the experiment were V1: Amritsagar (AAA), V2: Chenichampa (AAB), V3: Kachkal (ABB), V4: Bhimkal (BB) and two parts viz. S1: Peel and S2: Rhizome were selected from each cultivar for preparation of the samples. Chemical and mineral constituents of dried banana samples prepared from peels and rhizomes of the above cultivars were also estimated during the course of study. The experiment was laid out in factorial CRD with three replications. The results of the findings revealed that Kolakhar contained considerable amounts of nutrient, anti-nutrient and mineral elements and these chemical constituents of Kolakhar varied among the cultivars. Average moisture content was higher in fresh peels (83.68%) than the fresh rhizomes (81.39%) with the highest moisture content recorded in Bhimkal (V4: 83.91%). In fresh samples, the highest pH was recorded in Amritsagar (V: 6.07) followed by Bhimkal (V4: 5.91). Kolakhar samples of 10 per cent, 20 per cent and 30 per cent concentrations were prepared to estimate the pH and it was observed that average pH of both dried and ash (Kolakhar) samples prepared from peels and rhizomes of different cultivars increased with the increase in concentrations of solution from 10 per cent 30 per cent with similar trends of the highest and the lowest pH observed in all the three concentrations. Highest carbohydrate was recorded in Kolakhar prepared from peels (S1) of Kachkal (V3). Saponin content was found to be highest in Kolakhar prepared from rhizomes (S2) of Bhimkal (V4). The concentrations of the alkali elements recorded in the order of potassium>carbonate>sodium>calcium. Significantly highest values of carbonate (0.96 g/kg in dried samples and 22.32 g/kg in

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ash samples), sodium (1.93 g/kg in dried samples and 1.64 g/kg in ash samples) and calcium (1.20 g/kg in dried samples and 2.81 g/kg in ash samples) were recorded in rhizomes (S2) of Bhimkal (V4). Peels (S1) of Bhimkal (V4) recorded highest potassium content in both dried (43.20 g/kg) and ash samples (81.42 g/kg). Suitability of the banana cultivars for Kolakhar preparation decreased with increase in the *Musa acuminata* (A) genomic character and decrease in the *Musa balbisiana* (B) genomic character among the four cultivars under the present study i.e. with the increase of *Musa balbisiana* strains in banana cultivars pH increases in kolakhar. Kolakhar prepared from Bhimkal (BB) was found to be the best in quality among the four selected cultivars based on mineral contents and pH. As Kolakhar prepared from Bhimkal peel (S1V4) recorded lower amount of carbonate and antinutrient saponin and higher pH and higher amount of potassium and carbohydrate, therefore it was considered better over Kolakhar prepared from Bhimkal rhizomes (S2V4).

## **Organic Cultivation of Tuberose (*Polianthes tuberosa* L.)**

*Arishmita Gogoi*

An investigation was carried out during 2021-2022 to study the performance of tuberose (*Polianthes tuberosa* L.) as influenced by organic inputs in the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat. The experiment was laid out with 8 treatments in Randomized Block Design and replicated 3 times. The treatments were T1 { Microbial consortium (Azotobacter + PSB + KSB ) @ 5kg / ha + Rock Phosphate @ 100 kg / ha}, T2 {T1 +Vermicompost ( 2.5 t / ha)}, T3 {T1 + Vermicompost (5 t ha-1 )}, T4 {T1 + Improved compost (2.5 t ha-1 )}, T5 {T1 + Improved Compost (5 t ha-1 )}, T6 {Enriched Compost (2.5 t ha-1 )}, T7 {Enriched compost (5 t ha-1 )} and T8 {Absolute Control}. Most of the growth, flowering, and yield characters were found highest in T2 and T6 which were at par. The earliest shoot emergence of 37.61 days and 38.05 days, highest plant height of 92.20 cm and 91.58 cm, maximum number of leaves 50.07 and 49.92, and highest leaf area of 38.36 cm<sup>2</sup> and 37.85 cm<sup>2</sup> were observed respectively for T2 and T6 which did not differ significantly from each other for these characters. Early emergence of spike was recorded in the treatment T2(77.96 days) and T6 (78.11 days), both being at par. This trend was reflected in the early opening of the first floret (84.63 and 85.20days), highest number of spikes/bulb (7.09 and 6.98), highest number of florets/spike (32.78 and 31.08), spike length (74.30 cm and 72.83cm), rachis length (41.34 cm and 40.01cm) for T2 and T6 respectively. The highest self life (13.01days) and vase life (11.77 days) of spike were recorded in treatment T2 which were at par with T6 exhibiting a self life of 12.90 days and vase life of 11.52 days respectively. Largest size of floret (6.31 cm) , highest fresh weight of spike (110.00 g) and dry weight (12.30 g) were found in T2 . In case of bulb characters, T6 exhibited the highest number of bulbs (20.52), weight of clump (423.80g), highest number of economic bulbs (8.00) and largest bulb size (3.10) which was at par with T2. Among the physiological parameters, the highest total chlorophyll content in leaf, highest NAR and highest LRWC were recorded for T2 but at par with T6. But the highest LAD was recorded for T2 followed by T6. Soil parameters studies revealed that soil pH, OC, N, P, K, MBC and various soil enzyme activities were found highest in T7. Economics of production revealed that the highest B:C ratio of 6.02 was observed in the treatment T2 followed by 5.83 in T6.

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**Major Adviser: Dr. Madhumita Choudhury Talukdar**

## **Response of Assam lemon (*Citrus limon* L. Burm) to micronutrients**

*Baishali Bhuyan*

An experiment entitled “Response of Assam lemon (*Citrus limon* L. Burm.) to micronutrients” was conducted at the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat during 2018-19 to study the effect of micronutrient on growth and yield of Assam lemon and to study the effect on fruit drop. The experiment was laid out in a Randomized Block Design with eleven (11) treatments and with three (3) replications. The treatments were Control (T1), 20 g ZnSo<sub>4</sub> (T2), 40 g ZnSo<sub>4</sub> (T3), 20 g Borax (T4), 40 g Borax (T5), 0.2 % ZnSo<sub>4</sub>(T6), 0.2% Borax(T7), ZnSo<sub>4</sub> 10g + Borax 10g (T8), ZnSo<sub>4</sub> 20g + Borax 20g(T9), Micronutrient mixture 0.5% (T10), Tracel micronutrient mixture 20g (T11). Micronutrient mixture 0.5% (T10) contributed significantly towards the yield and yield attributing characters like fruit length (10.15cm), fruit weight (136.12 g), fruit volume (153.55cc), number of fruits per plant (305.22), fruit yield per plant (41.54kg). The result of the experiment revealed that the maximum number of hermaphrodite flowers (3.66) and the minimum number of male flower (2.00) were also recorded under T10. Similarly, the fruit set percent (80.78%) was significantly higher and fruit drop (13.08%) was the lowest. Minimum days to 50% flowering (64 days) after spraying the micronutrients was recorded with treatment T5 (Borax 40g). The growth characters like plant height, leaf area index, canopy area and days to ripening were found to be non-significant. Micronutrient sprays also brought about significant influence in fruit quality parameters. The minimum pulp: peel ratio (2.50), the maximum fruit juice content (38.00 ml) and ascorbic acid (2.01mg/ml) were obtained on application of 0.5% micronutrient mixture (T10). However, parameters like titrable acidity, TSS and TSS: TA ratio did not show any significant variation. An assessment on the economics of cultivation revealed that the highest benefit: cost ratio (3.03) was obtained from T10, followed by 2.97 in T11. From the present investigation, it can be concluded that foliar application of 0.5% micronutrient mixture is most effective for fruit quality improvement, yield attributing characters and total yield, leading to maximum profit in Assam lemon cultivation.

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**Major Adviser: Dr. Utpal Kotoky**

## **Effect of Vine Management on Growth and Yield of Pumpkin (*Cucurbita moschata* Poir.)**

*Barsha Nath*

The present study “Effect of vine management on growth and yield of Pumpkin (*Cucurbita moschata* Poir.)” was carried out at the Instructional cum Research Farm, Department of Horticulture, Biswanath College of Agriculture, Assam Agricultural University, Biswanath Chariali with the objectives viz., (i) To study the effect of vine management on growth, yield and quality of pumpkin and (ii) To study the incidence of pest and diseases. The experiment was laid out in RBD which consisted of 8 treatments with 3 replications. The treatments were: T<sub>1</sub> (Trimming of growing tip of the primary vine at 8th node stage), T<sub>2</sub> (Trimming of growing tip of the primary vine at 10th node stage), T<sub>3</sub> (Trimming of growing tip of the primary vine at 12th node stage), T<sub>4</sub> (Trimming of growing tip of the secondary vine at 6th node stage), T<sub>5</sub> (Trimming of growing tip of the secondary vine at 8th node stage), T<sub>6</sub> (Removal of all tertiary vines), T<sub>7</sub> (Retention of two tertiary vines) and T<sub>8</sub> (control without pruning). The study revealed that the morpho-physiological, phenological, yield and quality parameters were significantly influenced by different pruning treatments. Among the treatments, T<sub>4</sub> recorded the highest primary vine length (262.67 cm, 361.56 cm and 438.89 cm at 60, 90 DAS and at 1 st harvest, respectively) and inter-nodal length of primary vine at all three stages. Number of primary and secondary vines was found to be highest under T<sub>5</sub> and T<sub>3</sub>, respectively. T<sub>3</sub> further recorded the minimum days to appearance of first male (49.17 days), female (58.15 days) flowers, fruit set to harvest duration (51.43 days) and crop duration (110.55 days) while T<sub>8</sub> recorded the maximum days. T<sub>3</sub> recorded the highest total leaf chlorophyll content, relative leaf water content and leaf area index both at 60 and 90 DAS, respectively. Significant variation was observed in the yield parameters where T<sub>3</sub> recorded the maximum number of fruits (6.27), fruit yield per plant (15.47 kg) and yield per hectare (27.88 t/ha). Fruit characters such as fruit length, fruit diameter and number of seeds revealed no significant differences among the different treatments but with respect to quality parameters pruning revealed significant differences in terms of pulp thickness, vitamin A and ascorbic acid content. No serious incidence of pest and diseases were recorded as proper prophylactic measures were

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taken for all the treatments against the pest and diseases. The experiment thus concluded that the treatment T<sub>3</sub> (Trimming of growing tip of the primary vine at 12th node stage) produced the highest yield with higher B: C ratio of 2.52 and it can be recommended to the farmers of Assam in order to maximize the production and productivity of pumpkin.

## **Development of edible alkali (kolakhar) from Banana waste**

*Chemina Yesmin*

The present investigation focused on the development of edible alkali (kolakhar) from banana waste. Banana peels (P1), pseudo-stem (P2) and corm (P3) was taken from cultivar of *M. balbisiana* (C1), *M. paradisiaca* (C2) and wild types (C3). The parts of banana waste were then subjected to drying in oven and burring of dried material into ashes. Dispersion of ash was done in three concentrations viz., 50% (N1), 30% (N2) and 10% (N3). From the chemical evaluation pH was in between  $10.96 \pm 0.02$  (C3P1N3) and  $13.84 \pm 0.01$  (C2P2N1); total alkalinity in the developed alkaline solution was the highest in *M. paradisiaca* pseudo-stem with 50% ash concentration ( $49236 \pm 11.54$  mg/l); potassium bicarbonate recorded the highest ( $1.16 \pm 0.01\%$ ) in wild banana peel and the lowest ( $0.047 \pm 0.01\%$ ) in corm of *M. balbisiana*. The highest amount of potassium ( $1943.33 \pm 20.81$  ppm), and sodium ( $701.89 \pm 1.3$  mg/l) was found in C2P3N1 and C1P3N1 respectively. The lowest value of sodium was found in C3P3N3 ( $7.39 \pm 0.41$  mg/l), while magnesium ranged from  $7.55 \pm 0.03$  ppm (C3P1N3) to  $62.83 \pm 1.75$  ppm (C1P3N1). Calcium content was the highest ( $5.75 \pm 0.01$  mg/l) in *M. paradisiaca* corm with 50% ash concentration (C2P3N1). The highest amount of Iron was found in C2P1N1 ( $3.36 \pm 0.23$  mg/l). The highest value of zinc ( $0.34 \pm 0.43$  mg/l) was found both in C1P1N1 and C2P3N1; similarly the highest value of copper ( $0.36 \pm 0.004$  mg/l) was found in C2P1N3 and C2P3N1 and the lowest value ( $0.01 \pm 0.001$  mg/l) found was in C1P1N2 and in C3P3N3. The highest chloride was found in *M. paradisiaca* corm ( $24483.33 \pm 15.27$  mg/l) and the least was recorded in wild banana corm ( $3415.6 \pm 28.86$  mg/l). From the sensory evaluation of the edible alkali, the highest overall acceptability was recorded in C1P1N2 with 8 point hedonic rate.

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**Major Adviser: Dr. Pritom Kumar Borthakur**

## **Influence of Planting Time and Spacing on Growth, Yield and Quality of Zucchini (*Cucurbita pepo* L.) under Naturally Ventilated Polyhouse**

*Dhiraj Bhattacharjee*

An investigation was carried out during 2021-2022 to study the influence of planting time and spacing on growth, yield, and quality of Zucchini (*Cucurbita pepo* L.) under a naturally ventilated polyhouse in the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat. The experiment was laid out in Factorial Randomized Block Design with 4 different times of planting (10th November 2021, 1st December 2021, 20th December 2021 and 10th January 2022), and 3 spacings (45cm x 60cm, 60cm x 60cm, and 75cm x 60cm) with 3 replications. The results revealed that the highest plant height (34.75 cm & 34.21 cm at 30 DAS; 54.73cm & 53.91cm at 60 DAS; 85.40cm & 84.92 cm at 90 DAS) was recorded in the P3 planting and in S2 spacing. The number of leaves (12.62 & 11.79 at 30 DAS; 21.67 & 21.78 at 60 DAS; 29.48 & 27.89 in 90 DAS) was recorded highest in the P3 planting and in S2 spacing. Plant spread (0.82 m & 0.82m at 30 DAS; 1.10 m & 1.07m at 60 DAS; 1.30 m & 1.24 m at 90 DAS) and petiole length (29.12 cm & 28.13 cm at 30 DAS; 40.83 cm & 37.83 cm at 60 DAS; 49.72 cm & 48.39 cm at 90 DAS) differs significantly at P3 planting and in S2 spacing. Planting on P3 and S2 spacing resulted in the lowest nodal position of the first male flower (1.28 & 1.60), lowest nodal position of the first female flower (4.28 & 4.48), minimum days for initiation of first male flowers (22.05 days & 23.71 days), minimum days for initiation of first female flowers (27.75 days & 29.82 days), the minimum number of male flowers (16.17 & 16.67), The highest numbers of female flowers (8.60 & 8.16), minimum sex ratio (1.90 & 2.08), minimum days for the opening of female flower to harvesting (7.53 days & 7.87 days), minimum days to first (35.06 days & 36.20 days) and last harvest (58.89 days & 59.72 days), the highest fruit set % (99.63 % & 99.13 %) and the number of harvests (7.51 & 7.35). Number of fruits per plant (7.76 & 7.38), number of fruit yield per plant (2.98 kg & 3.04 kg), number of fruit yield per plot (46.60 kg & 48.65 kg), and number of fruit yield per hectare (103.15 tons & 108.11 tons) was recorded the highest in the P3 planting, and S2 spacing. Fruit physical parameters like fruit diameter (6.31 cm & 6.20 cm), fruit volume (502.82 cc &

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499.65 cc) and fruit weight (391.66 kg & 391.94 kg) was recorded highest in P3 planting and S2 spacing whereas fruit length (21.26 cm & 21.94 cm) is highest in P4 planting and S2 spacing. Moisture content of fruit (96.24 % & 95.31 %) was highest in P4 and S3 spacing whereas ascorbic acid content (38.46 mg/100g & 36.82 mg/100g) was highest in P2 and S3 spacing. Protein content of fruit (6.52 % & 6.42 %), total carotenoid content (8.37 µg/g), fibre content (0.91 %), ash content (0.65 % & 0.59 %) was recorded highest in the P3 planting and S3 spacing. TSS content (4.15 °brix & 3.95 °brix) was highest in P3. Fat content (0.66 mg & 0.67 mg) was highest in P4 planting and S3 spacing. Fibre content (0.90 %) in S2 spacing was found to be significantly different from other spacing. Zucchini yellow vein mosaic virus was considered to be a destructive disease and white fly incidence was considered to be a destructive insect pest for yield. Disease incidence and insect pest incidence were more in P2 (31.66 % and 41.66 %) planting time and lowest in P3 (2.16 %) and P4 (4.16 %). P3 with spacing S2 gave the best growth & yield under naturally ventilated polyhouse conditions with the highest B: C ratio of 3.87.

## **Value addition of some underutilized fruits through osmodehydration**

*Dibyajyoti Saikia*

The present investigation entitled “Value addition of some underutilized fruits through osmodehydration” was carried out during 2019-2021 in the laboratory, Department of Horticulture, B.N.College of Agriculture, AAU, Biswanath Chariali with two objectives viz. i) Effect of osmodehydration on nutrition and sensory quality of underutilized fruits and ii) Storage stability of the osmodehydrated fruits. The experiment was laid out in factorial CRD with three replications. The treatments consist of three osmotic concentration (B1:50%, B2:60% and B3:70%) with three osmotic time (T1:12 hours, T2:15 hours and T3:18 hours). The fruits selected for the experiment were Aonla (*Emblica officinalis*), Local ber (*Ziziphus mauritiana*), Carambola (*Averrhoa carambola*) and Mulberry (*Morus spp*). The osmotic solutions as well as osmotic time significantly influence the physicochemical parameters of osmo dehydrated fruits. The result of the study revealed that out of three osmotic concentration, 70 per cent was found to retain better nutrient content such as more ascorbic acid (286.8 mg/100g), phenolic content (118.11 mg/100g) and higher antioxidant activity (63.48%) in aonla fruit and ascorbic acid of 40mg /100g, calcium (44.23mg/100g) and vitamin A (17.55µg/100g) in ber fruit. Osmodehydrated aonla and ber fruit treated with 50 per cent osmotic solution showed minimum ascorbic acid, phenolic content antioxidant activity in aonla and Vitamin A and calcium in ber fruit. In case of mulberry fruit, higher iron content (23.11mg/100g) and antioxidant activity (56.45%) was noticed in fruit treated with 70 per cent osmotic solution whereas retention of anthocyanin was maximum when treated with 50 per cent osmotic solution. Similarly, carambola fruit treated with 65 per cent osmotic solution retained higher ascorbic acid (23.31 mg/100g) and potassium content (166.90 mg/100g) and lowest ascorbic acid, oxalate and potassium content was found in 45 per cent osmotic solution (B1). Among the three osmosis time, 18 hours dipping of fruit in osmotic solution showed superior to other two osmosis time (12hrs & 15hrs). However, the treatment combination of osmotic concentration and osmotic time B3T1 could retained more nutrient in all the fruits except the nutrient calcium and vitamin A in ber fruit, which was recorded more in B3T3. The antioxidant activity and

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nutrient present in all the fruits showed declining trend throughout the storage period except TSS and acidity content. However, dipping of fruit in 70 per cent osmotic solution for 18 hours was found best in terms of retention of nutrient as compared to fresh fruit.

## **Processing of Some Underutilized Fruits For Value Addition**

*Dikhasmita Bezbarua*

The present investigation entitled “Processing of some underutilized fruits for value addition” was carried out during 2020-2022 in the laboratory, Department of Horticulture, B.N.College of Agriculture, AAU, Biswanath Chariali with two objectives viz. i) Value addition of some underutilized fruit crops and ii) Physico-chemical properties of the value added products. Value addition is the process of changing or transforming a product from its original state to a more valuable state. Different value added products were prepared from Aonla (*Emblica officinalis*), Indian olive (*Elaeocarpus serratus*), Karonda (*Carissa carandas*), Elephant apple (*Dillenia indica*) and Mulberry (*Morus nigra*). Osmotic dehydration is a process of removing water from water-containing solid by osmotic pressure in the osmotic solution (Rastogi and Raghavarao, 2004). Osmodehydrated fruits were prepared from Aonla, Indian olive and Karonda by using three different concentration of osmotic solutions viz. 40<sup>o</sup>Bx, 50<sup>o</sup>Bx and 60<sup>o</sup>Bx with 5 per cent salt. Fruits were dried in cabinet dryer at 60<sup>o</sup>C for 6-8 hours depending upon the moisture content of the fruits. Observation on physical parameters (fruit length, fruit weight, diameter, seed weight) and biochemical parameters (TSS, acidity, ascorbic acid, Vit A, total phenolic content, total flavonoids, anthocyanin, antioxidant activity, sodium, iron, calcium, alkaloid and saponin) of value added products were recorded. Fruit jam was prepared from aonla, karonda and mulberry fruits as per specification of FSSAI. Jelly and murabba was prepared from Indian olive fruits. Similarly powder and pickle was prepared from elephant apple fruits. Fruits pretreated with 60<sup>o</sup>Bx was found superior in nutritional retention and sensory point of view. However, organoleptically aonla fruits pretreated with 50<sup>o</sup>Bx osmotic solution was found superior over 40<sup>o</sup>Bx and 50<sup>o</sup> Bx osmotic solutions. Among the prepared jam mulberry jam scored highest in organoleptic test. Organoleptically Indian olive jelly was preferred more over Indian olive murabba. Pickle and powder prepared from elephant apple was found to be acceptable from the organoleptic point of view and also found to retained original aroma along with appreciable amount of nutrients.

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## **Studies on Effect of Pre- Harvest Fruit Bagging on Yield and Quality of Litchi (*Litchi chinensis*)**

***Diplip Barman***

The present investigation entitled “Studies on Effect of Pre-Harvest fruit Bagging on Yield and Quality of Litchi (*Litchi chinensis*)” was conducted at the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat During 2021-2022. The experiment was laid out in Randomized Block Design (RBD) with seven (7) treatments and three (3) replications. The treatments taken under the study were Control (T1), Non-woven Red (T2), Non-woven Blue (T3), Non-woven White (T4) Nonwoven Green (T5), Non-woven Yellow (T6) and Polypropylene (T7). The objectives of the experiment were to find the effect of pre-harvest fruit bagging on the fruit quality & shelf life and standardization of suitable bagging materials. The morphological characters showed significant differences amongst the various treatments. The maximum fruit weight (17.81g), fruit volume (20.00cc), fruit breadth (3.16cm), fruit length (3.56cm), aril weight (14.28g), peel weight (2.31g), aril-peel ratio (7.17), seed weight (3.11g), aril-seed ratio (4.57) and yield (0.44kg/bunch) were recorded in T4 treatment (Non-woven White). Sun burn (8%) and fruit cracking (5.66%) percentage was observed lowest in T4 treatment (Non-woven White). No disease infestation was recorded in any of the treatments and 6% insect infestation was recorded in control (T1). In the biochemical characteristics, T4 treatment (Non-woven White) found the highest in the case of total soluble solids (16.63oB), juice content (7.63cc), reducing sugar (9.40%), invert sugar (15.16%), sucrose (6.63%), non-reducing (6.23%), total sugar (15.35%) and ascorbic acid (23.65mg/100g) whereas, the treatment recorded lowest in titratable acidity (0.63%). Deep red colour fruits of T7 treatment (Polypropylene) was due to high amount of anthocyanin content in the litchi (38.11mg/100g). Again T7 treatment (Polypropylene) recorded the highest calcium and phosphorus content i.e. 4.70mg/100 g and 4.03% respectively. During storage, highest shelf life was observed in T4 treatment (Non-woven White) i.e. 10.50 days with lowest decay %, physiological loss in weight, titratable acidity and highest in TSS content. In the sensory evaluation, highest score for texture and flavour was rated in T4 (Non-woven white) treatment i.e. 8.28 and 8.85 and for colour, highest score was rated in T7 treatment (polypropylene) i.e. 8.33. Thus, it can be concluded that all the bags studied in

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the present experiment were found to be good both in qualitative and quantitative characters and also increased shelf life. But the most superior one among the selected bags was non-woven white bag in terms of morphological, biochemical and shelf life characteristics.

## **Evaluation of some exotic varieties of tomato (*Lycopersicon esculentum* Mill.) for North Bank Plain Zone of Assa**

*Harshantar Borsaikia*

The present investigation entitled “Evaluation of some exotic varieties of tomato (*Lycopersicon esculentum* Mill.) for North Bank Plain Zone of Assam” was carried out during 2020-21 in ICR Farm, Department of Horticulture and laboratory of Crop Physiology, BN College of Agriculture, AAU, Biswanath Chariali with the following objectives (i) To study the morpho-physiological differences of different tomato varieties, (ii) To study the yield and quality of different tomato varieties and (iii) To document the incidence of pest and diseases. The experiment was laid out in RBD with three replications incorporating ten treatments viz., T1 = Madinapalli, T2= Monsarret, T3 = Red Cherry, T4= Balkon, T5= Karos, T6= Green Zebra, T7 = Bolster Granda, T8= Tika-Ks, T9= Muchamial and T10= Pusa Rubi. The morpho-physiological, yield and quality parameters were significantly influenced by different treatments. The significantly highest plant height (32.94 cm, 44.18 cm, 72.03 cm at 30, 45 and 60 DAT, respectively), number of branch ( 3.25, 5.82, 7.03 at 30, 45 and 60 DAT, respectively), leaf number per plant (20.05, 37.96, 62.55 at 30, 45 and 60 DAT, respectively), leaf area per plant (2036.26 cm<sup>2</sup> and 1196.88 cm<sup>2</sup> at 45 and 90 DAT, respectively), chlorophyll content of leaf (1.96 and 1.51 mg g<sup>-1</sup> fw at 45 and 90 DAT, respectively), Chlorophyll stability index of leaf (67.77% and 48.00% at 45 and 90 DAT, respectively) in T2, while they were lowest in T4. The shortest days to appear first flower was observed in T4 (29.28 days) whereas, T1 (43.50 days) took the longest time. Again minimum days to first harvest were observed in T4 (65.08 days) and the maximum in T2 (74.85 days). The maximum number of fruit per plant was observed in T1 (36.96), while it was minimum in T2 (14.43). In contrast the individual fruit weight was significantly highest in T2 (78.56g) among all the varieties. Similarly, the highest yield (44.74 t/ha) was recorded in T2 and the lowest yield was found in T4 (21.00 t/ha). The TSS (5.05o brix) content of fruit was maximum in T2. Lycopene content was maximum in T9 (9.49 µg/g) and ascorbic acid was maximum in T4 (30.93 mg/100g). No serious pest and diseases were noticed, however 11.23 to 21.33% late blight infestation was observed at the stage

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**Major Adviser: Dr. B. P. Gautam**

of crop maturity which was effectively controlled. A negative correlation between yield per plot and late blight incidence ( $r = -0.49$ ) was found. The experiment therefore, reveals T2 as the best variety among all varieties tested, which could be suggested for the growers of Assam.



## **Design and Development of Cold Plasma Generator for Food Application**

*Jaydev Barman*

Fruits and vegetables are perishable in nature. To increase their shelf life, different methods are being used. Application of heat and chemical treatment is often done. But, doing so frequently has negative impacts on the sensory, nutritional and functional aspects of foods, particularly in the fresh products. Cold Plasma (CP) exposure is a relatively new method to increase the shelf life of food products. In the present study, a gliding arc discharge (GAD) cold plasma generator was designed and developed to study its effect on microbial deactivation along with quality attributes. Successful generation of gliding arc plasma was achieved by using atmospheric air at 0.0723 m<sup>3</sup> /h rate of airflow through a DC air compressor, input voltage of 220 V, 50 Hz with an electrode gap of 1.8 mm. For optimization of the operational parameters, fresh strawberry samples were exposed to CP for different exposure times viz., 80 s, 100 s and 120 s. After CP treatment, the analyses were recorded on day 1, day 2 and day 3 of the treated and control samples. As compared to the control, the CP was successful to reduce the microbial load by 37.96 % after 80 s exposure, 40.78% after 100 s exposure and 66.16 % after 120 s exposures, respectively on day 1. On day 2, the microbial loads in the 80 s, 100 s, 120 s treated samples were 30.30%, 32.86% and 46.11% lower respectively as compared to the control. Similarly, on day 3, the loads were 24.77%, 32.90% and 47.22% lower in the treated samples as compared to their respective controls. The treatment duration of 120 s was effective in restricting the growth of microbes to nearly half of the initial surface microbiome i.e., more the treatment duration lesser were the growth of microbial population. The colour analysis of treated samples showed non-significant differences immediately after treatment. However,  $L^*$ ,  $a^*$ ,  $b^*$ , Hue and chroma values of strawberry samples decreased with days up to day 3. The total colour difference ( $\Delta E^*$ ) indices were found to be of high value in the case of control samples and of lower values in treated samples. The texture and sensory properties of treated samples showed non-significant difference with days up to day 3. Except on day 1, regarding taste and overall acceptability, there were significant differences among the treatments. Overall, it could be concluded that the developed technology is capable of minimizing the microbial load with no negative effect on

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colour, textural properties and sensory properties of strawberry samples. The developed CP generator, with an increased capacity, also opens up the possibility of treatment for other fruits and food products. Cold plasma pre-treatment can also be tried to improve the hot air-drying characteristics, kinetic parameters, and nutritional attributes of some other selected crops.

# **Performance of some local cultivars of Pumpkin of Karbi Anglong in North Bank Plain Zone of Assam**

*Jnandeep Mudoj*

The present investigation entitled “Performance of some local cultivars of Pumpkin of Karbi Anglong in North Bank Plain Zone of Assam” was carried out at the Instructional Cum Research Farm, Department of Horticulture, Biswanath College of Agriculture, Assam Agricultural University, Biswanath Chariali during 2019-20 with three objectives viz., i) To study morpho-physiological performances of different Pumpkin cultivars, ii) To study the yield and quality of different Pumpkin cultivars and iii) To document the incidence of pest and diseases. The experiment was laid out in RBD with three replications and seven treatments. The cultivars viz., T1, T2, T3, T4, T5 and T6 were collected from Karbi Anglong and T7 was collected locally from a farmer of Garahagi, Biswanath Chariali. Seeds were sown on prepared beds on 29 November, 2019. The cultivars were significantly different in respect of morpho-physiological, phenological, yield and quality parameters. Among the treatments, T3 produced the significantly highest vine length (447.62 cm and 532.77 cm at 90 and 120 DAS, respectively), number of primary branches per plant (7.86 and 8.86 at 90 and 120 DAS, respectively), number of functional leaf per plant (147.65 and 141.42 at 90 and 120 DAS, respectively), leaf area per plant (3.88 m<sup>2</sup> and 3.71 m<sup>2</sup> at 90 and 120 DAS, respectively), Specific leaf weight (22.87 mg/cm<sup>2</sup> and 18.01 mg/cm<sup>2</sup> at 90 and 120 DAS, respectively), total leaf chlorophyll content (2.18 and 1.53 mg g<sup>-1</sup> fw at 90 and 120 DAS, respectively), chlorophyll stability index (71.95% and 69.56% at 90 and 120 DAS, respectively) and relative water content (83.99% and 74.14% at 90 and 120 DAS, respectively) while, they were lowest in T6. On the other hand the highest fresh weight of leaf (23.08g and 21.72 g at 90 and 120 DAS, respectively) and dry weight of leaf (6.48 g and 5.28 g at 90 and 120 DAS, respectively) were produced by T1 while they were lowest in T6. The longest duration to appear the first male flower (60.22 days) and female flower (72.07 days) were recorded in T7, while the shortest duration (53.31 days and 62.02 days for male flower and female flower, respectively) were recorded in T3. Similarly the highest male : female flower ratio (17.89) was recorded in T7, while the

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lowest was observed in T3 (11.37). In contrast, T4 took shortest duration (121.77 days) and T7 took the longest duration (133.88 days) to first harvest. Again the number of fruit per plant was highest in T3 (5.03) and lowest in T7 (2.25). Whereas individual fruit weight (3.06 kg), fruit diameter (19.81 cm), pulp thickness (4.87 cm) and number of seeds per fruit (563.12) were recorded highest in T7 while they were lowest in T6. The highest fruit yield per plant (7.99 kg) was recorded in T3 and the lowest in T6 (4.27 kg). The treatment T3 produced highest significant fruit yield (26.63 t/ha) and T6 produced the lowest (14.23 t/ha). The TSS (8.39 o brix) and  $\beta$ -carotene content (6.05 mg/100g) were highest in T3 and lowest in T6 (5.16 o brix and 4.25 mg/100g for TSS and  $\beta$ -carotene, respectively) while ascorbic acid content (5.18 mg/100g) was highest in T7 and lowest in T6 (3.48 mg/100g). No serious incidence of pest and diseases were observed during the period of investigation. The experiment, therefore revealed T3 as the best cultivar among all cultivars tested which could be well cultivated in North Bank Plane Zone of Assam.

## **Integrated nutrient management in lettuce (*Lactuca sativa* L.)**

*Kangkana Nath*

A field experiment was conducted at the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat during the year 2019-20 and 2020-21 to study the effect of integrated nutrient management on growth, yield and quality of lettuce. The experiment was laid out in a randomized block design (RBD) with eight treatments replicated thrice. The treatments were T1: Control, T2: 40:20:40 Kg NPK ha<sup>-1</sup>, T3: 40:20:40 Kg NPK ha<sup>-1</sup>+ FYM 2t ha<sup>-1</sup>, T4: 40:20:40 Kg NPK ha<sup>-1</sup> +FYM 2t ha<sup>-1</sup> + PSB, T5: FYM 3t ha<sup>-1</sup>+ PSB, T6: 40:20:40 Kg NPK ha<sup>-1</sup> +VC 1t ha<sup>-1</sup>, T7: 40:20:40 Kg NPK ha<sup>-1</sup> + VC 1t ha<sup>-1</sup> +PSB and T8: VC 2t ha<sup>-1</sup> + PSB. Observations of the growth parameters were taken at 30 days after planting (DAP), 45 days after planting (DAP) and at harvest. Analysis of variance during 2019-20, 2020-21 and across the years revealed significant mean square due to treatment for all the characters under study. The characters studied were plant height, leaves per plant, leaf length, leaf breadth, leaf canopy spread, leaf area, fresh weight, dry weight, days to marketable maturity, yield per plot and yield per hectare. The pooled analysis across 2019-20 and 2020-21 revealed that the treatment T7 recorded maximum plant height (14.25cm, 19.17cm and 26.92cm) and maximum leaves per plant (10.00, 17.17 and 29.17) at 30 DAP, 45 DAP and at harvest, respectively. The leaves per plant in the treatment T4 (9.88) at 30 DAP was statistically at par with treatment T7. Maximum leaf length (16.33cm, 22.67cm and 27.64cm) and leaf breadth (16.08cm, 22.17cm and 27.67cm) were exhibited by the treatment T7 at all the three growth stages. Leaf length in the treatments T4 (16.00cm) and T6 (15.48cm) were statistically at par with treatment T7 at 30 DAP. Maximum leaf canopy spread (12.6cm, 21.33cm and 29.75cm) and maximum leaf area (198.95cm<sup>2</sup>, 347.29cm<sup>2</sup> and 543.33cm<sup>2</sup>) were observed in the treatment T7 at 30 DAP, 45 DAP and at harvest, respectively. Maximum fresh weight of leaves (206.33g) as well as dry weight of leaves per plant (13.85g) were exhibited by the treatment T7 whereas, minimum of these were recorded by the treatment T1. The highest yield (27.5 t/ha) was exhibited by the treatment T7. Minimum number of days to reach the marketable maturity was observed in the treatments T4 and T7 with values 53 days whereas maximum number of days (63 days) for the same character was observed in the treatment T1. The highest moisture content (96.28 %) was observed in the

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treatment T6. The integrated application of organic, inorganic and biofertilizers influenced the nutritional content of lettuce significantly. The ascorbic acid content (3.76mg/100g), calcium content (20.67mg/100g), non-reducing sugar content (3.98 %) and chlorophyll content (3.77mg/100g) were recorded maximum in treatment T7 whereas the maximum iron content (1.50 mg/100g) was observed in the treatment T5. The highest nitrogen (0.23%) and the crude protein content (1.44%) were observed in both the treatments T6 and T7. Maximum reducing sugar content was observed in T4. The highest net return (Rs. 192703.00) was obtained in the treatment T7 with benefit cost ratio 2.34. However, the highest benefit cost ratio was exhibited by the treatment T4 (2.58) with a net return of Rs. 189703.00 due to high cost of production in T7

## **Performance of African marigold (*Tagetes erecta*) as influenced by organic inputs**

*Kamir Taropi*

An investigation was carried out in the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat-13, during 2020-2021 to investigate the "Performance of African marigold (*Tagetes erecta*) as influenced by organic inputs." The experiment was set up in a Randomized Block Design with seven treatments and three replications. The treatments were T1 {RDF (10:10:10 g/m<sup>2</sup> NPK) + FYM @ 4 kg/m<sup>2</sup> }, T2 {Vermicompost (2.5t/ha) + Rock Phosphate (100 kg/ha) + Microbial consortium}, T3 {Vermicompost (5t/ha) + Rock phosphate (100 kg/ha) + Microbial consortium}, T4 {compost (2.5t/ha) + Rock phosphate (100 kg/ha) + Microbial consortium}, T5 {Compost (5t/ha) + Rock phosphate (100kg/ha) + Microbial consortium}, T6 {Enriched compost (2.5 t/ha)} and T7 {Enriched compost (5 t/ha)}. From the result it was observed that the application of different nutrition sources had a substantial impact on growth and flowering of marigold. Treatment T3 and T7 showed the highest levels of growth and flowering traits. T3 reported the highest plant height (50.88 cm), number of branches (78.33), number of leaves (259.77), plant spread (34.90 cm), and leaf area index (1.54). The earliest days to bud visibility was recorded in treatment T3 (59.33 days) and T7 (60.33 days). This trend also reflected in earliest days to full bloom T3 (75.33 days) and T7 (75.67 days). The maximum value for flower diameter (6.02 cm), fresh weight of flower (5.56 g), number of flowers per plant (85.67), number of ray florets (144.67) and disc florets (58.33) was recorded highest in treatment T3. The treatment T3 further exhibited maximum loose flower life (8.10) and also recorded the highest yield per plant (470.02 g) and yield per ha (271.00 q). Among the physiological parameters, the highest total chlorophyll content in leaf (2.83 mg g<sup>-1</sup> fresh wt.), Net assimilation rate (0.0070 mg cm<sup>-2</sup> day<sup>-1</sup> ), Relative water content (87.30%), Leaf area duration (88.85 days) and whole plant biomass was recorded in the treatment T3. While T7 exhibited the highest values for soil pH, soil moisture content, organic Carbon, available Nitrogen, Phosphorus, Potassium, Microbial Biomass Carbon and various soil enzymes followed by T3. Economics of production revealed that the highest B:C ratio of 2.19 was observed in the treatment T3 followed by 2.02 in T7. Hence considering the positive effect on growth, yield, quality and soil health, T3 and T7 both can be considered best for adopting at the field level to reap good economic yield accompanied by better quality and sustainable soil health.

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**Major Adviser: Dr. Sangita Mahanta**

## **Growth, yield and quality of Zucchini (*Cucurbita pepo*) as influenced by fertilizers and planting time**

*Masoom Mohanty*

A field experiment was conducted in Experimental Farm, Department of Horticulture, AAU, Jorhat during 2019-20 with a view to standardize the conducive planting time and fertilizer rates for growth, yield and quality of zucchini (*Cucurbita pepo*). The seeds were sown and the seedlings were transplanted in three planting dates P1 (1st December); P2 (15th December) and P3 (1st January) under four fertilizer treatments viz. T0 (control/blank); T1 (45: 48: 48: NPK Kg/ha); T2 (60: 64: 64: NPK Kg/ha); and T3 (75: 80: 80: NPK Kg/ha). The experiment was set up utilizing a split-plot design with three replications. The results revealed that the fertilizer treatments showed significant variations for all crop growth, flowering, yield, and yield attributing parameters. Quality parameters such as fiber, ash and  $\beta$ -carotene varied significantly to fertilizer rates. Maximum results for plant height (27.02 cm, 30 DAT; 61.25 cm, 60 DAT), number of leaves per plant (11.94, 30 DAT; 21.94, 60 DAT), plant spread (0.78 m, 30 DAT; 1.00 m, 60 DAT), petiole length (30.13 cm, 30 DAT), nodal position of first male flower and female flower (7.05 cm, 16.75 cm), days of initiation of first male flower and first female flower (27.63, 37.10), number of male flower and female flower (136.56, 8.61) respectively was observed in higher fertilizer treatment (T3). T3 also resulted in minimum sex ratio (15.91) and highest, number of days required from opening of female flower to harvesting (8.01), number of days to last harvest (68.60), number of harvest (9.20) and number of fruits per plant (8.21). Whereas T0 showed lowest number of days from opening of female flower to harvesting (7.77) and number of days to first harvest (54.66). Fruit diameter (5.33 cm), fruit length (18.74 cm), fruit weight, fruit yield per plant, fruit yield per plot, fruit yield per hectare (350.18 g, 2.87 kg, 46.04 kg, 142.12 ton) respectively was also recorded highest in T3. Among quality parameters, T3 caused maximum results in fat (0.67%), fiber (0.88%), protein content of fruit (6.28%), minimum results for moisture content (95.41%). However,  $\beta$ -carotene content (7.69 mg/100g) was found maximum in T0. Significant variations were found due to planting time for crop growth parameters such as number of leaves per plant, plant spread and petiole length; flowering, yield and yield attributing parameters, fruit weight, fruit diameter and fruit quality parameters such as fiber, ash and  $\beta$ -carotene

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content. First planting (P1) reflected maximum results for plant height (26.87 cm, 30 DAT; 59.31 cm, 60 DAT), number of leaves per plant (11.97, 30 DAT; 21.92, 60 DAT), plant spread (0.91 m, 30 DAT; 1.00 m, 60 DAT), petiole length(39.37 cm, 30 DAT), days of initiation of first male flower (25.29), number of female flowers (8.84), nodal position of first male flower (5.91 cm), and minimum Sex ratio (15.17). While maximum days of initiations of first female flower (36.79), number of days required from opening of female flower to harvesting (7.92), nodal position of first female flower (15.33) and number of male flowers (136.25) were found to in later planting i.e. P3. Number of days to first harvest (53.67) was found minimum in P1. Yield attributing characters such as number of harvest (9.22), number of days to last harvest (67.36), fruit diameter (5.38 cm), fruit length (18.98 cm), fruit weight (303.07 g), number of fruits per plant (8.16), fruit yield per plant (2.48 kg), fruit yield per plot(39.82 kg), fruit yield per hectare (122.41 kg) were found maximum in P1. Fruit quality parameter such as  $\beta$ -carotene (7.68 mg/100g), protein (6.30 %), fiber (0.92 %), ash content (0.59 %) was found highest in P1. However, moisture content (96.13 %) was found maximum in P3. Petiole length, number of female flowers, sex ratio, number of days to first and last harvest, number of harvest, number of fruits per plant, fruit length and  $\beta$ -carotene showed significant variations for interactions effects. T3 P1 showed better results for growth, yield and quality parameters except for  $\beta$ -carotene (7.70 mg/100g) which gave best result in TOP1 and TOP2 treatment combinations.

## **Organic Amendments for Growth, Yield and Quality of Green Coriander (*Coriandrum sativum* L.)**

*Mausum Kumar Nath*

The investigation entitled ‘Organic amendments for growth, yield and quality of Green Coriander (*Coriandrum sativum* L.)’ was conducted during 2021-22 in the organic block of Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat. The experiment was laid out with 7 treatments in Randomized Block Design and replicated 3 times. The treatments were T1 (Absolute control), T2 (Vermicompost @ 2.5 t ha<sup>-1</sup>), T3 (Vermicompost @ 2.5 t ha<sup>-1</sup>+ microbial consortium), T4 (Vermicompost @ 5 t ha<sup>-1</sup>), T5 (Vermicompost @ 5 t ha<sup>-1</sup>+ microbial consortium), T6 (Enriched compost @ 2.5 t ha<sup>-1</sup>) and T7 (Enriched compost @ 5 t ha<sup>-1</sup>). The maximum plant height (24.45 cm), number of leaves per plant (33.99), number of branches per plant (12.05), weight of the whole plant (13.77 g), number of plants per square metre (95.33), yield (0.56 Kg m<sup>-2</sup>) and root: shoot ratio (0.49) was observed in T7. The plant biomass was recorded highest in T7. In case of the quality parameters, the highest moisture content (86.88%), ascorbic acid (99.82 mg 100-g), iron content (22.71 mg 100-g), protein content (4.03 g 100-g) was obtained in T7. T5 recorded the maximum fibre content (8.27%) and ash content (4.12%). Among the physiological parameters, the highest total chlorophyll content (1.84 mg 100-g) in leaf was recorded in T7 while, highest relative leaf water content (85.57%) was recorded in T5. The highest nitrogen (29.75 Kg ha<sup>-1</sup>), phosphorus (9.04 Kg ha<sup>-1</sup>) and potassium (15.98 Kg ha<sup>-1</sup>) uptake by plant was obtained in T7. Soil physicochemical and biological properties showed significant differences among the treatments. The treatment T7 recorded the best for all the soil parameters viz., soil pH (5.15), organic carbon (0.90%), available N (270.33 Kg ha<sup>-1</sup>), available P (52.71 Kg ha<sup>-1</sup>), available K (173.31 Kg ha<sup>-1</sup>), microbial biomass carbon (298.41 µg g<sup>-1</sup> soil 24hr<sup>-1</sup>), phosphomonoesterase activity (67.05 µg p-nitrophenol g<sup>-1</sup> soil 24hr<sup>-1</sup>) and fluorescein diacetate hydrolysis (10.17 µg fluorescein g<sup>-1</sup> h<sup>-1</sup>). Economics of production revealed that the highest benefit-cost ratio of 3.18 was observed in the treatment T7 followed by 3.09 in T6. Hence, considering the positive effect on growth, yield, quality and soil health, T7 (Enriched compost @ 5 t ha<sup>-1</sup>) is considered the best treatment for adopting under field conditions.

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**Abstract of M.Sc. thesis**

**Department: Horticulture**

**Major Adviser: Dr. Jumi Saikia**

## **Development of Value Added Products From Mushroom (*Pleurotus ostreatus*)**

*Monjula Deka*

Mushrooms are nutrient rich versatile food which can address many problems of under-nutrition and malnutrition. They are partaken as a replacement of meat, fish, fruits, and vegetables. Unfortunately, mushrooms are highly perishable and their availability is also seasonal. Thus it is important to process mushrooms into value added products which will not only cater to the protein and micronutrient requirement of masses but also will solve the problem of short shelf-life and postharvest losses of mushrooms. The present study focused on development of value added products like pasta and nuggets from mushroom. Pasta and nuggets were prepared with combination of mushrooms. Five nuggets samples were prepared with different proportions of Mushroom powder (50%) , unmlated blackgram powder (40 – 48.5 %) , malted blackgram powder ( 40 – 48.5%) ,banana pseudostem (9-10%) and guar gum (0.5%). Four pasta samples were prepared using a single screw extruder and subjected to different drying conditions viz oven drying and sun drying with following combinations, T1 (10% mushroom powder , 90% flour ,oven dried) , T2 (100% flour , oventdried), T3(10% mushroom powder , 90% flour, sun dried ), T4 (100% flour , sundried) . Both the nuggets and pasta were evaluated for their physico chemical properties (moisture, ash, fat, crude fibre, crude protein, carbohydrate , energy content) and mineral content ( iron , zinc , magnesium and potassium ) upto 90 days storage period. Incorporation of banana pseudostem increased the level of crude fibre content in the developed nuggets. Protein content was increased with the supplementation of mushroom powder and malted blackgram powder. Guar gum facilitated the binding of all the ingredients together and added to a better texture in the developed nuggets. Based on the organoleptic evaluation, nuggets prepared with T4( 50% mushroom powder, 40 % malted blackgram powder, 9 % banana pseudostem , 0.5 % salt and 0.5% ginger powder) treatment had more protein(14.37g/100g -14.06g/100g), minerals zinc (2.44mg/100g) , magnesium(14.84mg/100g)was highly accepted in terms of overall acceptability. Pasta prepared with (10% mushroom powder and 90% flour, oven dried ) contained the highest content of crude protein (16.22 – 15.56 ) , ash (1.98 – 1.77 ),crude fibre ( 0.54 -0.34 ) , carbohydrate (73.13 -72.35 ) , energy (363.77 -353.93) and minerals

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**Department: Horticulture (FST)**

**Major Adviser: Dr. Madhumita Barooah**

viz. iron (3.35mg/100g), zinc (0.67mg/100g), magnesium( 10.17mg/100g), potassium( 334.98mg/100g). Further research work on extending the selflife of these products along with analysis of physiochemical and nutritional qualities will pave the way for making these products acceptable. There is vast scope of developing other value added mushroom products viz., soup mix, shakes, burgers including, bakery products like cookies, cakes, breads and buns, pastries.

## **Standardization of taro (*Colocasia esculenta*) based papads**

*Munni Das*

Papad is a popular Indian traditional snack item consumed after frying and roasting. The present study was carried out in two stages. Twelve types of flour blends were prepared to make papads, each set containing six blends. Set-I contained blends of taro flour and black gram malt flour in different ratios viz. (10:90) S1T1, (20:80) S1T2, (30:70) S1T3, (40:60) S1T4, (50:50) S1T5 and (60:40) S1T6. Set-II contained blends of taro and black gram malt flour in different ratios viz. (10:90) S2T1, (20:80) S2T2, (30:70) S2T3, (40:60) S2T4, (50:50) S2T5 and (60:40) S2T6. Developed papads were subjected to sensory analysis and the treatments with highest and second highest scores from each set were selected for nutritional analysis. From the sensory evaluation of the products, the highest overall acceptability was recorded in S1T4 (7.85) both in fried and roasted type and second highest in S1T2 (7.55) fried and (7.50) in roasted type, hence they were selected from Set-I. From Set-II, the treatments S2T4 (7.10- fried, 7.05-roasted) and S2T5 (6.90- fried, 6.95- roasted) were selected. It was observed that the nutritional properties of the selected taro based papads varied significantly and were found to retain most of the nutritional qualities. The nutritional analysis at the end of storage period showed that the treatments retained a good amount of protein [i.e., S1T4 (20.41 g/100g), S1T2 (20.66 g/100g), S2T4 (16.66 g/100g) and S2T5 (16.61 g/100g)] carbohydrate [i.e., S1T4 (74.63 g/100g), S1T2 (64.33 g/100g), S2T4 (70.73 g/100g) and S2T5 (77.09 g/100g)] as well as crude fibre [i.e., S1T4 (3.72%), S1T2 (3.85%), S2T4 (4.33%) and S2T5 (3.95%)]. The developed products were also found to be organoleptically acceptable at the end of 50 days of storage without much deterioration in quality. The expansion percent of the selected treatments of papads of taro, black gram malt and unmalted black gram were found to be varied significantly. The study revealed that the treatment S1T4 with 60% black gram malt flour and 40% taro flour showed the highest overall acceptability as well as a high amount of carbohydrate and protein content.

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**Abstract of M.Sc. thesis**

**Department: Horticulture, FST**

**Major Adviser: Dr. Sheriful Alam**

## **Effect of 3G Cutting on Growth, Yield and Quality Of Watermelon (*Citrullus lanatus*)**

*Murchana Deka*

An experiment was conducted on “Effect of 3G cutting on growth, yield and quality of Watermelon (*Citrullus lanatus*)” at Instructional cum Research Farm, Department of Horticulture, Biswanath College of Agriculture, Assam Agricultural University, Biswanath Chariali to study on influence of management of number of secondary and tertiary branches on growth, yield and quality of watermelon and record of incidence of diseases. Ten treatments were laid out in Randomized Block Design with three replications under field condition. The treatments were T<sub>1</sub> (Without any treatment (Natural growth), T<sub>2</sub> (2 secondary branches pinching at 50-60 cm with 2 tertiary branches per secondary branch), T<sub>3</sub> (2 secondary branches pinching at 70-80 cm with 3 tertiary branches per secondary branch), T<sub>4</sub> (2 secondary branches pinching at 90-100 cm with 4 tertiary branches per secondary branch), T<sub>5</sub> (3 secondary branches pinching at 50-60 cm with 2 tertiary branches per secondary branch), T<sub>6</sub> (3 secondary branches pinching at 70-80 cm with 3 tertiary branches per secondary branch), T<sub>7</sub> (3 secondary branches pinching at 90-100 cm with 4 tertiary branches per secondary branch), T<sub>8</sub> (4 secondary branches pinching at 50-60 cm with 2 tertiary branches per secondary branch), T<sub>9</sub> (4 secondary branches pinching at 70-80 cm with 3 tertiary branches per secondary branch) and T<sub>10</sub> (4 secondary branches pinching at 90-100 cm with 4 tertiary branches per secondary branch). The F<sub>1</sub> hybrid “Saraswati” was selected for the study. The result of the experiment revealed that the growth parameters were significantly influenced by different treatments. The highest number (27.49) of leaves per main vine was recorded in T<sub>7</sub> and the lowest number of leaves in T<sub>3</sub> (22.39). The highest value for the number of leaves per secondary branches was observed in T<sub>10</sub> (24.71) and it was not significantly different from the values of T<sub>7</sub> (23.94). The highest values for number of leaves per tertiary branches (19.38), total leaf area (7.53 m<sup>2</sup>) of the vine, maximum leaf area index (1.53), number of internodes per main vine (27.88) were observed in T<sub>7</sub>. The treatment T<sub>7</sub> required the shortest period for the appearance of male flower (31.0 days) and female flower (81.0 days) after sowing of seeds. In contrast to that, T<sub>4</sub> required the longest period for appearance of male flower (35.17 days) and female flower (88.50 days) were required by T<sub>4</sub> and T<sub>3</sub>, respectively. The shortest

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duration required for flowering to harvest (57.83 days) and the shortest crop duration (138.83 days) were recorded in T<sub>7</sub> as compared to rest of the treatments. Yield attributing characters were also significantly influenced by different treatments. The lowest number of male flowers (108.83) per vine, the highest number of female flowers (37.67) per vine, lowest fruit drop (17.33%), highest number of fruits (5.88) per vine, longest fruit (30.44 cm), maximum girth of fruit (53.23 cm), heaviest fruit (2.27 kg/fruit), highest fruit yield (12.88kg/vine, 51.51kg/plot and 257.53q/ha) were recorded in T<sub>7</sub>. The lowest number of female flowers (22.0) per vine, the highest percentage fruit drop (39.64%) per vine, the lowest fruit weight (1.80 kg) and lowest yield (190.00q/ha) were recorded in T<sub>1</sub>. There was no significant differences in male and female flower ratio, percentage of fruit set per vine, fruit diameter, fruit volume, fruit rind thickness, pulp weight and number of seeds per fruit between all the treatments. The fruits produced under T<sub>7</sub> recorded the maximum TSS (9.28°Brix), lowest titratable acidity (1.61%) and highest TSS:acid ratio (5.76%). There were no significant differences in juice content, total sugar, reducing and non-reducing sugar among all the treatments. Economics of cultivation was calculated out and the highest net return (Rs. 2,10,274.00) and benefit:cost ratio (2.12) was recorded in T<sub>7</sub> followed by net return of Rs. 1,98,922.00 and benefit:cost ratio of 2.01 in T<sub>9</sub>. The lowest net return (Rs. 1,29,238.00) and benefit:cost ratio (1.30) was recorded in T<sub>1</sub> followed by T<sub>3</sub> with net return of Rs. 1,58,998.00 and benefit:cost ratio of 1.60. Therefore, T<sub>7</sub> is considered as the best treatment for the highest yield, quality and maximum amount of profit.

## **Performance of Palak (*Beta vulgaris* var. *bengalensis* Hort.) as influenced by organic inputs, microbial consortium and packaging materials**

*Okenmang Jamoh*

The experiment was carried out on Palak (*Beta vulgaris* var. *bengalensis* Hort.) during 2019-20 and 2020-21 at the Experimental Farm, Department of Horticulture, Assam Agriculture University, Jorhat to assess the Performance of Palak (*Beta vulgaris* var. *bengalensis* Hort.) as influenced by organic inputs, microbial consortium and packaging material. The field experiment was conducted in Randomized Block Design with nine treatments and three replications. The treatments were T0 (Control), T1 (Rockphosphate + Microbial Consortium), T2 (T1 + Compost @ 2.5t ha<sup>-1</sup>), T3 (T1+ Compost @ 5t ha<sup>-1</sup>), T4 (T1 + Vermicompost @ 2t ha<sup>-1</sup>), T5 (T1+ Vermicompost @ 4t ha<sup>-1</sup>), T6 (Enriched compost @ 1.5t ha<sup>-1</sup>), T7 (Enriched compost @ 3t ha<sup>-1</sup>) and T8 (FYM @ 20t ha<sup>-1</sup> + NPK @ 80:60:0 kg ha<sup>-1</sup>). After harvesting the palak plants were packed in two packaging materials i.e., S1 (Wet hessian cloth) and S2 (Wet muslin cloth) to improve the shelf-life. This experiment was laid out in Factorial Completely Randomized Design. Pooled analysis over two years revealed that the maximum plant height (35.90 cm), numbers of leaves per plant (21.43), leaf area (292.91cm<sup>2</sup>), whole plant weight (51.26g), yield (2.97kg m<sup>-2</sup>) was observed in T8. However, a similar trend was followed in T7 and the leaf blade petiole ratio was seen best in the same treatment. In the case of the quality parameters, the highest ascorbic acid (70.54mg 100-g), iron content (15.71mg 100-g), total carotenoid content (3.87mg 100-g), and total phenol (23.29mg 100-g) was obtained in T7. T8 recorded the maximum moisture content (89.76%), chlorophyll content (1.63mg g<sup>-1</sup>), crude fibre content (11.53%), oxalate content (575.31mg 100-g) and T5 obtained the highest ash content (7.86%). Soil physicochemical and biological characters showed significant differences among the treatments. The treatment, T7 recorded the best for all the soil parameters viz., soil pH (5.70), organic carbon (1.45%), available N (289.57kg ha<sup>-1</sup>), available P (64.50kg ha<sup>-1</sup>), available K (138.91kg ha<sup>-1</sup>), microbial biomass carbon (408.39µg g<sup>-1</sup> soil 24hr<sup>-1</sup>), dehydrogenase activity (118.26µg TPF g<sup>-1</sup> soil 24hr<sup>-1</sup>), phosphomonoesterase activity (64.33µg p-nitrophenol g<sup>-1</sup> soil 24hr<sup>-1</sup>), bacterial population (6.48log cfu g<sup>-1</sup> soil) and

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fungus population ( $3.80 \log \text{ cfu g}^{-1} \text{ soil}$ ). The result showed that post-harvest characters viz., physiological loss in weight, yellowing percentage and decaying percentage increase with the increase in storage period. The treatment, S1T7 (Wet hessian cloth + T7 (Enriched compost @  $3 \text{ t ha}^{-1}$ )) showed a minimum loss in physiological loss in weight (3.39%, 7.17%, 12.30%, and 15.14%) and yellowing percentage (3.60%, 5.49%, 8.54%, and 11.37%) during all the storage of 2nd, 4th, 6th and 8th days. However, S2T7 (Wet muslin cloth + T7 (Enriched compost @  $3 \text{ t ha}^{-1}$ )) observed minimum decaying of 1.73% and 3.45% during the 6th day and 8th day of storage. The combined treatment S1T7 (Wet hessian cloth + T7 (Enriched compost @  $3 \text{ t ha}^{-1}$ )) shows the best from all the other treatments and lasted the longest in aspects of freshness. Thus, S1 can be considered better packaging material for enhancement of shelf-life and treatment T7 exhibited best with a longer shelf life of 8 days. The cost economics was observed to be superior in T8 with a 4.41 benefit-cost ratio followed by T7 (4.40). Hence considering, the positive effect on growth yield, quality, shelf-life, and soil health, T7 (Enriched compost @  $3 \text{ t ha}^{-1}$ ) is considered the best organic inputs to reap better quality, longer shelf life, better soil health, and higher economic return. Packaging material, S1 (Wet hessian cloth) appeared to be the better packaging material for shelf-life enhancement of palak leaves.

## **Morphological and Quality Evaluation of elite litchi cultivars in Jorhat**

*Pansurika Saikia*

The study on ‘Morphological and Quality Evaluation of elite litchi cultivars in Jorhat’ was conducted at the Experimental Farm, Department of Horticulture in Assam Agricultural University, Jorhat during 2019-2020. The experiment was laid out in Randomized Block Design (RBD) with five (5) treatments and four (4) replications. The treatments taken under the study were some elite cultivars such as Bombay, Seedless, Piajee, Bilati and Elaichi. The objectives of the experiment were to study the morphological and biochemical characters of selected cultivars of litchi in Jorhat. The morphological characters showed significant differences among the cultivars in terms of canopy area, number of flowers per branch, duration of flowering, time of flowering to fruit setting, flowering to harvesting, number of fruits per plant, fruit weight, fruit volume, fruit diameter, fruit length, aril weight, peel weight, aril thickness, aril-peel ratio, seed weight, seed length and seed diameter except in plant height. No significant difference was observed in plant height among the different cultivars under the study. The plant types observed in litchi cultivars were irregular, spherical, broadly pyramidal, elliptical and oblong, while the leaf shapes were lanceolate, elliptic oval and elliptic oblong. The time of flowering of litchi varied from last week of February to the second week of March. The most acceptable time for the ripening of fruits was in the month of May. The maximum number of fruits per branch(53.00), fruit weight (25.40g), fruit diameter (12.92cm), fruit volume (27.35cc) and aril weight(16.62g) were recorded in T4 (Bilati). In the case of aril thickness and aril-peel ratio, the highest was observed in T2 (Seedless). But, the cultivar T4 (Bilati) was found out to be the most preferable one in morphological characters among all the cultivars under the present study. In the biochemical characteristics, T4 (Bilati) found the highest in the case of juice content (13.62cc), reducing sugar (8.37%), invert sugar (17.44%), sucrose (8.60%), total sugar (16.99%), sugar-acid ratio (40.71), potassium (1263.75mg/100g), vitamin C (62.11mg/100g), anthocyanin content (38.41mg/100g) and colour density (3.87), whereas, the cultivar recorded lowest in titratable acidity (0.42%), anthocyanin degradation index (3.52) and polymery colour (0.60). Deep red colour fruits of T4 (Bilati) were due to the highest anthocyanin content in the cultivar. The variation

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observed in the morphological and biochemical characters of the litchi cultivars might be due to the inherent characteristics of the cultivar and its response to soil type and climatic condition of that region. In the case of yield and yield attributing characters also, the highest was found in the cultivar T4 (Bilati). Thus, it can be concluded that all the cultivars studied in the present experiment were found to be good both in qualitative and quantitative characters. But the most superior one among the selected cultivars of litchi was T4 (Bilati) in terms of morphological, biochemical and yield characteristics.

## **Standardization of Planting Time and Spacing of Garland Chrysanthemum (*Glebionis coronaria* (L.) Cass. ex Spach) in Assam**

*Plato Basumatary*

The present investigation was conducted in the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat during the period of 2021-22, with a view to standardize the planting time and spacing of Garland chrysanthemum for loose flower production in Assam condition. The experiment was laid out in Factorial Randomised Block Design (RBD) with 4 different times of planting (15th October, 15th November, 15<sup>th</sup> December and 15<sup>th</sup> January) and 2 spacings (30cm x 30cm and 45cm x 30cm) with 3 replications. The results revealed that all the treatments significantly influenced the growth and flowering of garland chrysanthemum cv. "Shubra". Highest plant height (33.13 cm at 30 DAT, 58.33 cm at 60 DAT and 145.67 cm at full bloom) was recorded in the 15th October planting with closer spacing (30cm x 30cm). 15th November planting along with wider spacing (45cm x 30cm) resulted in superior growth parameters like plant spread (53.35 cm at full bloom), number of lateral branches (21.73 at full bloom), main stem diameter (1.84 cm), number of leaves (1093 at full bloom), leaf length, leaf breadth and leaf area (35.37 cm<sup>2</sup>). Earliest flower bud initiation (27.33 DAT) and 50% flowering (50.00 DAT) was observed in 15th January planting with closer spacing (30cm x 30cm). Maximum flower diameter (7.45 cm), flower weight (5.27 g), flower production (148.78 flowers per plant and flower yield of 0.74 kg per plant) was recorded in the 15th November planting + 45cm x 30cm. However, the maximum flower yield in terms of area (604.35 q/ha) was observed in 15th November planting with closer spacing (30cm x 30cm). Highest flowering duration (64.94 days), shelf life of loose flowers (4.05 days), shelf life of prepared garlands (4.08 days) was found in 15th October planting. The disease incidence was more in 15th January planting (71.67 %). The highest benefit cost ratio (B:C) 9.61 was attained in D<sub>2</sub>S<sub>1</sub> treatment combination (15<sup>th</sup> November planting + 30cm x 30cm spacing). From the experiment it was observed that the vegetative and floral parameters were influenced by planting time and spacing, which may be due to the environmental conditions prevailing at different months and the competition among the plant population at different spacing.

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15<sup>th</sup> November planting showed the better performance in most of the vegetative growth and flower characters, while closer spacing (30cm x 30cm) resulted in higher yield per hectare, therefore this combination maybe considered the best for loose flower production of garland chrysanthemum for the agro climatic condition of Jorhat, Assam, which also gave the highest B:C ratio (9.61).

## **Growth, flowering and corm production of gladiolus (*Gladiolus grandiflorus* L.) as influenced by nitrogen and phosphorus**

*Polashi Kachari*

An experiment entitled “Growth, flowering and corm production of gladiolus (*Gladiolus grandiflorus* L.) as influenced by nitrogen and phosphorus” was carried out in the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat during 2019-2020. The treatments referred to four levels of nitrogen viz., 0, 5, 10 and 15 g/m<sup>2</sup>, four levels of phosphorus viz., 0, 3, 6 and 9 g/m<sup>2</sup> and a constant dose of potassium viz., 6 g/m<sup>2</sup>. Hence, there were sixteen (4×4) combinations of various treatments of nitrogen and phosphorus and one additional treatment i.e. RDF (NPK::1:2:2 @ 56 g/m<sup>2</sup>) and each treatment was replicated three times in a Factorial Randomized Block Design. The mean performance of growth and yield parameters revealed that nitrogen level N<sub>3</sub> (N 15 g/m<sup>2</sup>) recorded the maximum values for most of the growth as well as yield attributing characters viz. plant height (144.47 cm), number of leaves (8.14), breadth of leaves (5.35 cm), number of spikes per plant (1.78), length of spike (104.18 cm), flower diameter (10.36 cm), highest self-life (16.00 days) and vase life (11.33 days) and highest fresh weight of spike (90.93 g). In case of corm parameters, N<sub>3</sub> (N 15 g/m<sup>2</sup>) also recorded maximum number of corms (1.87) and cormels (29.90) and highest weight (91.03 g) of corm. In respect of phosphorus levels, P<sub>3</sub> (P<sub>2</sub>O<sub>5</sub> 9 g/m<sup>2</sup>) recorded the highest plant height (137.26 cm), number of leaves (7.82), breadth of leaves (4.92 cm), maximum number of spikes per plant (1.70), highest length of spike (100.35 cm), flower diameter (10.22 cm), self-life (15.39 days) and vase life (10.83 days), fresh weight of spike (84.62) and maximum weight of corm (84.28 g). Interaction between nitrogen and phosphorus showed that, N<sub>3</sub>P<sub>3</sub> (N:P<sub>2</sub>O<sub>5</sub> @ 15:9 g/m<sup>2</sup>) was superior in respect of the key parameters like plant height (147.24 cm), number of leaves (9.21), number of florets per spike (18.27), length of spike (107.52 cm), fresh weight of spike (97.46 g), self-life (16.80 days) and vase life (11.86 days) of spike and weight of corm (102.24 g) and cormels (13.65 g). From economic point of view, combination of N<sub>3</sub>P<sub>3</sub> (N:P<sub>2</sub>O<sub>5</sub> @ 15:9 g/m<sup>2</sup>) recorded the highest B:C ratio of 3.15 against the lowest B : C ratio of 1.52 in control treatment. Hence considering the best

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values in respect of vegetative, floral, corm characteristics and benefit-cost ratio, the treatment combination of nitrogen at 15 g/m<sup>2</sup>, phosphorus at 9 g/m<sup>2</sup> and potassium at 6 g/m<sup>2</sup> (Urea, SSP and MOP @ 32.6 g, 56.25 g and 10 g/m<sup>2</sup>) could be considered as the best treatment and can be effectively applied for commercial cultivation of gladiolus under Assam (Jorhat) conditions.

## **Influence of planting dates and growing condition on yield and quality of Gladiolus (*Gladiolus grandiflorus* L.) cv. Red Candyman**

*Prasanta Kumar Das*

The present investigation entitled “Influence of planting dates and growing condition on yield and quality of Gladiolus (*Gladiolus grandiflorus* L.) cv. Red Candyman” was carried out during 2019-2020 in the Instructional cum Research Farm, Department of Horticulture, B.N. College of Agriculture, AAU, Biswanath Chariali with three objectives viz., i) Study the effect of planting dates and growing condition on yield and quality, ii) Study the performance under two growing condition and iii) Study incidence of disease during the growing period. The experiment was laid out in factorial RBD with three replications. The treatments were: Six dates of planting (15th August, 15th September, 15th October, 15th November, 15th December and 15th January) with two growing condition (Open condition and Shade net house). Planting dates and growing condition had significant effect on morphological and phenological characters. Maximum plant height (109.53 cm), number of leaves per plant (11.16), leaf breadth (4.24 cm) were observed in 15th August planting. Whereas minimum plant height (105.50 cm), number of leaves per plant (7.16) and leaf breadth (3.78 cm) were recorded under 15th January planting. However minimum days to sprouting of corms (9.01 days), days taken for spike initiation (65.19 days) were observed in 15th August planting. Whereas maximum days to sprouting of corms (11.56 days), days taken for spike initiation (70.79 days) were observed in 15th January planting. Yield characters were also significantly influenced by planting dates and growing condition. Maximum number of spike per corm (1.83), longest spike (79.53 cm), longest rachis (53.71 cm), number of floret per spike (12.99), flower diameter (10.11 cm), corm diameter (6.86 cm), corm weight (47.85 g), number of corms per plant (3.16) were observed in 15th August planting and minimum were observed in 15th January planting. Among growing condition, morphological, phenological and yield characters were found superior in Open condition as compared to Shade net house. Regarding post harvest characters, planting dates and growing condition had significant effect. Maximum days taken to open first floret (2.83 days), longevity of florets (2.85 days), vase life of spike (10.91

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days) were observed in 15th October planting and minimum were observed in 15th 15 th August planting. Maximum water uptake of spike (55.84 ml), percentage of open floret (9.32%), fresh weight (89.21g) and dry weight (11.69 g) were observed in 15th August planting. 15th October planting was found to superior for post harvest characters. Minor incidence of Fusarium wilt, Curvularia leaf spot, Sclerotium rot, aphid, cutworm were observed under both Open condition and Shade net house and were controlled using mild dose of chemicals during the investigation.

## **Rapid Field Multiplication of Banana Using Different Treatments**

*Priyam Nandini Baruah*

An experiment on “Rapid field multiplication of banana using different treatments” was conducted at Instructional cum Research Farm, Department of Horticulture, Biswanath College of Agriculture, Assam Agricultural University, Biswanath Chariali to study the effect of different treatments on sucker production of banana and to evaluate the suitable treatment to increase the sucker production. Two varieties of banana i.e., Malbhog (AAB) and Amritsagar (AAA) were selected for the experiment. Eight treatments were laid out in randomized block design with three replications under field condition. The treatments were T1 (Natural sucker production), T2 (Decortication of sucker), T3 (Natural sucker production + BAP @ 3 ppm), T4 (Natural sucker production + BAP @ 6 ppm), T5 (Decortication of sucker+ BAP @ 3 ppm), T6 (Decortication of sucker + BAP @ 6 ppm), T7 (Natural sucker production + N @ 220 g/plant) and T8 (Decortication of sucker + N @ 220 g/plant) The result of the experiment revealed that emergence of first sucker was significantly influenced by different treatments. The first sucker emerged within a shortest period of 25.48 days in T6 (decorticated rhizome treated with BAP @ 6 ppm) and was at par with T5 (26.64 days). The maximum time required for sucker emergence after planting was recorded in T7 (31.88 days) which had no significance difference with T8 (31.85). The plants treated with T6 recorded the significantly highest number of sucker (9.00) per plant at 150th day after planting followed by 8.42 in T5 and lowest number of sucker (4.92) per plant was recorded in T1 (natural sucker production) at 150th day after planting. The height of suckers was found to increase gradually from 60th day (98.14 cm) to 150th day (147.50 cm) due to highly significant effect of T8 (decorticated rhizomes applied with N) followed by T7 (natural sucker applied with N) at 60th day (92.0 cm) to 150th day (139.50 cm). The girth of suckers also varied significantly due to different treatments and the highest girth of sucker at 60th day after planting was recorded in T6 (22.26 cm) while the highest girth at 90th day (29.12 cm) and at 120th day (36.34 cm) were observed in T5. But the girth of plants treated with T2 became larger (41.00 cm) at 150th day after emergence. There was no significant effect of any treatment or interaction effect between varieties and treatment on phyllochron of suckers The number

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of leaves of first sucker at 90th day after emergence was recorded to be highest (5.75) in T1 (natural sucker production) followed by 5.68 in T8 (decorticated rhizomes treated with N), 5.61 in T4 and 5.34 in T3. The highest weight of sucker (2.71 kg) was recorded in T1 followed by 2.68 kg in T6 (decorticated rhizomes treated with BAP @ 6 ppm) at 90th day after planting. Considering the shortest time taken for first sucker emergence (25.48 days), highest number of suckers (9.00) per plant, weight of the sucker (2.68 kg/sucker) and benefit:cost ratio of 2.36 in T6 (decorticated sucker treated with BAP @ 6 ppm) was found to be the most suitable treatment to increase the production of sizeable suckers within 3-4 months.

## **Response of *Phaius tankervilleae* Bl. and *Spathoglottis plicata* Bl. to various nutrient concentration levels**

*Priyakshi Saikia*

An experiment was conducted in the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat during 2019-2021, to study on “Response of *Phaius tankervilleae* Bl. and *Spathoglottis plicata* Bl. to various nutrient concentration levels.”. The experiment was laid out in Randomized Block Design with seven treatments replicated thrice. The treatments were T1 (RDF+Zn (500ppm), T2 (RDF+Zn (750ppm), T3 (RDF+Zn (1000ppm), T4 (RDF+Ca (250ppm), T5 (RDF+Ca (500ppm), T6 (RDF+Ca (750ppm), T7 (Control:RDF 19 All). The results revealed that all the growth characters were significantly influenced by mineral nutrients. Amongst the treatments, T5 (RDF+Ca (500ppm), was the best for increasing all the growth characters for both the species viz., plant height (56.27cm, 54.37cm), number of leaves (12.33,10.33), leaf length (53.07cm,62.1cm), leaf width (9.67cm,7.80cm), leaf area (469.23cm<sup>2</sup> , 440.70cm<sup>2</sup> ), stem diameter (7.07cm, 5.97cm) and number of pseudobulbs (2.80, 2.57). Treatment T2 (RDF+Zn (750ppm) exhibited minimum days for inflorescence visibility (50.87,203.13), bud development (142.80,259.20), days to half bloom (146.30,264.03) and days to full bloom (148.77,267.13) as well as highest value for spike length (66.73cm, 104.67cm), floret diameter (9.67cm,5.37cm), stalk girth (3.67cm, 1.63 cm), number of florets per spike (12.93, 11), number of spikes per plant (2.50, 3.90), self life (17.80, 15.33), vase life (10.43, 9.20), fresh weight at harvest (61.67g, 10.80g) and fresh weight at senescence (22.80g, 5.47g). Regarding the physiological characters T2 (RDF+Zn (750ppm) was best for increasing total chlorophyll content (1.55mg g<sup>-1</sup> fw, 1.52mg g<sup>-1</sup> fw), stomatal number (37.13, 42.09) and stomatal size (5.80  $\mu$ m<sup>2</sup> and 5.73 $\mu$ m<sup>2</sup> ). For soil characters for both the species no significant changes were observed in case of soil pH and the available N content, however the available P and K were found highest in T5 (RDF+Ca (500ppm). Evaluation from the economics of cultivation, it can be concluded that the highest benefit cost ratio of 6.74 for *Phaius tankervilleae* Bl. was obtained in T2 (RDF+Zn (750ppm) and for *Spathoglottis plicata* Bl. the highest benefit cost ratio of 5.51 was recorded in T2 (RDF+Zn (750ppm).

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## **Studies on development and evaluation of Dragon fruit (*Hylocereus costaricensis*) blended mixed fruit jam**

*Rajnandini Gogoi*

The present investigation was undertaken in the Quality Control Laboratory and Food processing Laboratory of the department of Horticulture Assam Agricultural university, Jorhat. The research was carried out in the year 2019-2021 with an aim to standardized of procedure of making Dragon fruit (*Hylocereus costaricensis*) based jam with Pineapple (*Ananas comosus*), Banana (*Musa*), Pear (*Pyrus communis*) in different proportions. The experiment was laid out with five treatments with three replications. The products were analysed for physico-chemical, nutritional and sensory evaluation at an interval of 30 days till 60 days of storage period at ambient temperature. The experiment was conducted by using Completely Randomized Design (CRD). The study revealed that the physico-chemical parameters like pH, ascorbic acid, non-reducing sugar decreased significantly from 0 day to 60 days whereas the acidity, TSS, reducing sugar were found to increase significantly in all the treatments during storage. Among the nutritional evaluation moisture, protein, crude fiber, fat decrease from 0 day to 60 days. The carbohydrates increased significantly from 0 day to 60 days of storage and the ash content remained constant. However significant degradation in organoleptic score was observed in the dragon fruit based jam during storage period. Based on physico-chemical, nutritional and organoleptic evaluation T1 consisting Dragon fruit 70%: Pineapple 10% : Banana 10% : Pear 10% was found to be the best mixed fruit jam which can be stored in acceptable conditions up to 60 days under ambient conditions. Considering the facts that people are becoming more conscious about their health, also want more variety in diet, this product may have great commercial prospect.

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## **Intercropping in Assam Lemon (*Citrus limon*)**

*Rasen Bey*

The present investigation was conducted in the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat during the period of 2021-22, with a view to evaluate the effect of intercropping on the growth parameters of Assam Lemon, the yield of intercrops, and on soil parameters. The experiment was laid out in a Split plot design with 4 main plots having {M<sub>1</sub>(sole Assam Lemon), M<sub>2</sub> (Assam Lemon + Broccoli), M<sub>3</sub> (Assam Lemon + French Bean), and M<sub>4</sub> (Assam Lemon + Spinach Beet)} and 3 sub plots having {S<sub>1</sub> (Cowpea), S<sub>2</sub> (Amaranthus) and S<sub>3</sub>(Okra)} with 5 replications. The results revealed that Assam Lemon + Broccoli (M<sub>2</sub>) had maximum plant height (71.31 cm), maximum girth (2.06 cm), maximum N-S plant spread (70.76 cm), maximum E-W plant spread (76.54), maximum plant canopy area (4270.29 cm<sup>2</sup>) and maximum plant canopy volume (97597.75 cm<sup>3</sup>) respectively during winter. And summer intercropping with Cowpea (S<sub>1</sub>) had the maximum plant height (67.56 cm), girth (2.01 cm), maximum N-S plant spread (67.64 cm), maximum E-W plant spread (75.44), plant canopy area, and plant canopy volume (4075.26 cm<sup>2</sup> and 88570.23 cm<sup>3</sup>) respectively. The study on soil parameters revealed that Assam Lemon + Broccoli (M<sub>2</sub>) had the highest soil pH (4.66), Soil Organic Carbon (0.58%), N (176.52 kg ha<sup>-1</sup>), P (9.86 kg ha<sup>-1</sup>), and K (126.90 kg ha<sup>-1</sup>) respectively during winter. And summer intercropping with Cowpea (S<sub>1</sub>) had the highest soil pH (4.60), Soil Organic Carbon (0.57%), N (174.02 kg ha<sup>-1</sup>), P (9.79 kg ha<sup>-1</sup>), and K (125.76 kg ha<sup>-1</sup>) respectively. Among the Lemon Equivalent Yield (LEY) of the intercrops, Broccoli gave the highest Lemon Equivalent Yield (7.35 t ha<sup>-1</sup> in M<sub>2</sub>S<sub>1</sub>, 7.12 t ha<sup>-1</sup> in M<sub>2</sub>S<sub>3</sub>, and 7.05 t ha<sup>-1</sup> in M<sub>2</sub>S<sub>2</sub>) followed by Amaranthus (4.8 t ha<sup>-1</sup> in M<sub>3</sub>S<sub>2</sub>, 4.65 t ha<sup>-1</sup> in both M<sub>2</sub>S<sub>2</sub> and M<sub>4</sub>S<sub>2</sub>). For the system total, the maximum LEY (11.80 t ha<sup>-1</sup>) was recorded in M<sub>2</sub>S<sub>1</sub> where Assam Lemon was intercropped with Broccoli followed by Cowpea. From this field experiment, it is evident that Assam Lemon + Broccoli – Cowpea (M<sub>2</sub>S<sub>1</sub>) was found to be the best treatment for the growth of Assam Lemon. And M<sub>2</sub>S<sub>1</sub> was also found to improve the soil condition of the orchard. Thus, Assam Lemon intercropped with Broccoli in winter followed by Cowpea in summer not only improves the growth of Assam Lemon but also improves the soil condition of the Assam Lemon orchard and also generates additional income to the farmers during the pre-bearing stage.

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## **Integrated nutrient management in mango (*Mangifera indica* L.) cv. Amrapali**

*Ritika Mehta*

An experiment entitled “Integrated nutrient management in mango (*Mangifera indica*) cv. Amrapali” was conducted during 2019-2021 at Experimental Farm, Department of Horticulture, Assam Agriculture University, Jorhat-13 with the objective to determine the effect of Integrated Nutrient Management (INM) on flowering, yield and biochemical constituents of mango and to determine the economics of cultivation. The experiment was laid out in Randomized Block Design with eight number of treatments which were replicated three times. The treatments are T0 : Absolute control, T1 : RDF (730 g N : 180 g P : 680 g K) + FYM plant-1 , T2 : 75% RDF + FYM + Vermicompost (3 kg) + Azotobacter + PSB plant-1 , T3: 50% RDF + FYM + Vermicompost (5 kg) + Azotobacter + PSB plant-1 , T4: 75% RDF + FYM + Vermicompost (3 kg) + Azotobacter + PSB + Rock phosphate (100g) plant-1 , T5: 50% RDF + FYM + Vermicompost (5 kg) + Azotobacter + PSB + Rock phosphate (200 g) plant-1 , T6: 75% RDF + FYM + Enriched compost (3 kg) + Azotobacter + PSB plant-1 , T7: 50% RDF + FYM + Enriched compost (5 kg) + Azotobacter + PSB plant-1 . Azotobacter and PSB were applied 5 g each per kg of the compost and FYM was applied 20 kg per plant in every treatment from T1 to T7. Field data was taken for the two years i.e., 2019-2020 and 2020-2021 and the biochemical parameters were evaluated only during the year 2019-2020. During the first year of experiment, Days to 50% inflorescence emergence and Days to 50% flowering, were found to be non-significant. However, integrated application of nutrients had significant difference among each other during the second year of experiment. Pooled analysis over the two years revealed that the minimum days to 50% inflorescence emergence (133.58), minimum days to 50% flowering (143.24), maximum length of panicle (27.74 cm), number of rachis per branch (26.72), percentage of fruit set (33.34), fruit size (10.24 cm), yield per plant (14.60 kg) and pulp-peel ratio (6.31) were observed in T4. Percentage of fruit drop was also found to be lowest in treatment T4. Quality parameters like TSS (22.09° Brix), reducing sugar (4.94%), non-reducing sugar (12.15%) was found to be highest in T4.  $\beta$  carotene content was found to be maximum in treatment T2 which was statistically at par with treatment T4. Titratable acidity and crude fibre were found

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to be non-significant among the treatments. Results revealed that maximum available nitrogen (286.28 kg/ha), phosphorus (48.55 kg/ha), potassium (183.66 kg/ha) and organic carbon (0.99%) was found in treatment T4. pH among the treatments was observed to be non-significant. The net return and B:C ratio were found to be highest in treatment T4 followed by treatment T2. Thus, in a broader view, treatment T4 was better towards improving the flowering, yield and biochemical constituents of mango which is followed by treatment T2. Hence, considering the above points and based on results of experiment, treatment T4 [75% RDF + FYM (20 kg) + Vermicompost (3 kg) + Azotobacter (15 g) + PSB (15 g) + Rock phosphate (100 g) plant<sup>-1</sup> ] is considered best for recommendation which is followed by treatment T2 [75% RDF + FYM (20 kg) + Vermicompost (3 kg) + Azotobacter (15 g) + PSB (15 g)] plant<sup>-1</sup> .



# **Standardization of planting time, planting methods and pinching techniques for summer season cut flower production of *Zinnia elegans* in Assam**

*Rubul Baruah*

The experiment entitled “Standardization of planting time, planting methods and pinching techniques for summer season cut flower production of *Zinnia elegans* in Assam” was undertaken in the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat during the year 2020-2021 to find out the most suitable combination of planting time, method of planting and stage of pinching for *Zinnia elegans* cv. Dreamland Mix. The field experiment, laid out in Randomized Block Design with three replications, comprised of three planting dates viz., mid of January, February and March, two planting methods viz., direct sowing of seeds in the main field and transplanting of seedlings, and two stages of pinching viz., single pinching at 3 pairs of leaves and double pinching, viz., 1st pinching at 3 pairs of leaves stage followed by 2<sup>nd</sup> pinching of lateral shoots at 15 days after 1st pinching. The results revealed that all the treatments had a significant influence on growth and flowering of *Zinnia elegans*. Taller plants (24.55 cm and 33.73 cm at 30 DAT and at full bloom stage, respectively) with longer flower stalks (10.15 cm) were obtained from February transplanted seedlings subjected to single pinching. The number of branches per plant (16.44), number of flowers per plant (21.22), main stem diameter (1.35 cm), flower stalk diameter (7.22 mm) and total flowering duration (29.22 days) were higher with double pinching in February transplanted seedlings. From the present study, it may be inferred that for summer season cut flower production, *Zinnia* seedlings should be transplanted in the month of February followed by pinching at 3 pair leaves stage and 15 days after 1<sup>st</sup> pinching. A laboratory experiment was conducted in Department of Horticulture, AAU, Jorhat, to study the effect of various pulsing treatments on the post harvest life of *Zinnia elegans* cv. „Dreamland Mix” cut flowers. The post-harvest experiment was laid out in Completely Randomized Design with 9 treatments replicated thrice. The pulsing treatments were distilled water, sucrose solution (2%, 4%, 6%, 8%), 2% sucrose + 200ppm 8-HQS, 4% sucrose + 200 ppm 8-HQS, 6% sucrose + 200 ppm 8-HQS, and 8%

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sucrose + 200ppm 8-HQS. Pulsing with 4% sucrose + 200 ppm 8-HQS registered the maximum vase solution uptake (6.65 g/flower stem), higher fresh weight (91.33%), delayed petal discoloration (9.32 days), higher relative water content (60.7%) and the lowest bacterial count (4.86 CFU/ml) which finally led to longest vase life (10.5 days) of zinnia cut flowers.

## **Growth Behaviour and Nutritional Profiling of Microgreens**

*Rumanchita Gogoi*

Microgreens have gained increasing popularity in recent years amongst the health conscious people and chefs because of their nutritive value and sensorial attributes. The present investigation was conducted in the Department of Horticulture, Assam Agricultural University, Jorhat-785013 during the period 2020 to 2021. Ten different types of microgreens, viz., broccoli, kohlrabi, mung beans, mustard, pakchoi, pink radish, red cabbage, sango radish, turnip and white radish were evaluated for growth and yield characteristics. The crops were cultivated on microgreen trays with two batches per month for 12 months in a mixture of cocopeat, perlite and vermiculite (3:1:1 v/v). Nutrition evaluation of the crops was done on every third month. The microgreens showed uniform growth behaviour throughout the year. Pink radish (93.06%), sango radish (94.14%) and white radish (93.11%) microgreens had high germination rate. Shoot population density (53,853) and shoot fresh weight (153.55g) were highest in kohlrabi microgreens while mung bean microgreens had the lowest (26,369 and 70.84g respectively). Red cabbage microgreens had highest moisture (93.39%) and ascorbic acid (132.88mg/100g) contents. Mung bean microgreens had the highest carbohydrate (7.87g/100g) and protein (4.19g/100g) contents. Mustard microgreens (14.80%) had highest dry matter content. Phytic acid content was highest in pink radish microgreens (0.75mg/100g). Tannin (0.41 g/100g) and carotenoid (7.46mg/100g) contents were highest in broccoli microgreens.

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# **Effect of Different Treatments and Dates of Sowing on Seed Germination, Growth, Yield and Quality of Watermelon (*Citrullus lanatus*) in the North Bank Plain Zones of Assam**

*Sangeeta Mahajan*

A field experiment was carried out to study the effects of different treatments and dates of sowing on seed germination, growth, yield and quality of watermelon (*Citrullus lanatus*) at the Instructional cum Research Farm of Biswanath College of Agriculture, Assam Agricultural University, Biswanath Chariali during 2021-2022. The study was based on two prime objectives which were: a) To determine the effect of different treatments on germination of watermelon seeds and b) To standardize the suitable time of sowing on growth, yield and quality of watermelon. The experiment was laid out in Factorial RBD with 3 replications and 15 treatment combinations viz. 5 treatments (T1: Control, T2: Covering of pits with black polythene sheet [100 micron thickness], T3: Covering of pits with paddy straw [10 cm thickness layer], T4: Covering of pits with dry banana leaves [10 cm thickness layer], T5: Filling the pits with fresh cow dung) and 3 dates of sowing (D1: November'21, D2: December'21, D3: January'22). The management practices were followed as per recommended package of practices. The study revealed that different growing times and treatments have influenced the germination, growth and yield of watermelon. The data on seed emergence percentage showed a progressive decrease from D1 (93.99%), followed by D2 (89.29%) and D3 (85.89%) as well as the Germination Rate Index was also observed to decline gradually from D1 (20.77%), followed by D2 (16.31%) and D3 (14.06%) while these two parameters performed best under T5 with 93.27% and 20.24% respectively. The plant characters like number of leaves per vine, number of internodes per vine, total leaf area and Leaf Area Index were observed to perform better under D3T5 as compared to other treatments, whereas the phenological parameters like days required to first male flowering (44.28 days), days to first female flowering (42.83 days), days required from flowering to harvesting (36.62 days) and crop duration (83.43 days) showed minimum values under D3 but number of days required for seed emergence was

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found to be the lowest under D1 (5.40 days). The fruit quality parameters were more or less unaffected by the application of treatments and showed non significant values. The plant characters were found better under T5 whereas leaf area of the vine (7.51) and Leaf Area Index (1.50) were highest in the vines treated with T2. The fruit characters like fruit weight, length, girth, rind thickness etc. performed better under T1 as well as the maximum yield of fruits was obtained in T1 while the qualitative characters were not much affected by the application of different treatments.

## **Comparative performance of marigold hybrids (*Tagetes erecta* L.) in different planting dates**

*Saptarisha Chetia*

A field experiment entitled “Comparative performance of marigold hybrids (*Tagetes erecta* L.) in different planting dates” was undertaken with the objectives to find out the optimum planting date and hybrid variety suitable for Assam condition. To achieve these objectives, three different planting dates (November, December and January) and eight different marigold hybrid varieties (Inca Yellow, Inca Orange, Vanilla, African Double Orange, Purple, Inca Gold, Maxima and Divya) were considered and the trial was carried out at the Experimental Farm, Department of Horticulture, Assam Agricultural University during 2019-2020. Different characters relating to growth, flower and physiological characters were assessed to find out the suitable planting date and hybrid variety for Assam condition. The variety African Double Orange, Inca Yellow and Inca Orange were superior during the vegetative phase. African Double Orange recorded the maximum plant height (56.38 cm), number of branches per plant (25.66), number of leaves per plant (248.32), root number (44.23) and root length (24.52 cm). Inca Yellow was superior in leaf breadth (9.40 cm) and leaf area (150.95 cm<sup>2</sup>). With respect to the flower characters, Inca Orange followed by Inca Yellow and Inca Gold recorded the superior characters. Inca Orange recorded the maximum flower diameter (11.62 cm), fresh flower weight (19.96 g), self life of flowers (17.22 days), loose life of flowers (5.04 days), number of ray florets (228.93) and flower yield per plant (515.95 g). Maximum blooming duration was recorded in Inca Yellow (58.54 days). African Double Orange gave the highest number of flowers per plant (45.93) but it recorded less flower diameter, fresh flower weight, yield of flowers per plant and also took maximum days to full bloom. Among the physiological parameters, Inca Yellow recorded the highest chlorophyll content (24.23 mg/g), leaf area duration (97.47 days), net assimilation rate (0.047 mg/cm<sup>2</sup>) and relative leaf water content (95.88 %). Inca Orange recorded the maximum carotenoid content (0.273 mg/g). Among the three planting dates, November planted varieties showed the maximum growth and flower characters and also in the physiological parameters. In the interaction effect between the planting dates and the hybrids, Inca Orange showed the best

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performance regarding the flower characters in all the three different planting dates. While African Double Orange showed the maximum performance in growth characters followed by Inca Yellow and Inca Orange in all the planting dates. Regarding the physiological parameters, Inca Yellow followed by Inca Orange recorded the best results. Hence, Inca Orange followed by Inca Yellow can be regarded as the suitable varieties. Among the three planting dates, November is concluded as the best planting date for marigold in Assam condition.

## **Morphological evaluation of long pepper (*Piper longum*) germplasm**

*Srikanth P. N.*

The present investigation entitled “Morphological evaluation of long pepper (*Piper longum*) germplasm” was conducted in the Experimental Farm, Department of Horticulture, College of Agriculture, Assam Agricultural University, Jorhat-13 during the year 2020-2021. Fourteen diverse germplasm and one check variety of long pepper were evaluated in a randomized block design with three replications to study the amount of genetic variability present in the base population. Further, the knowledge of genetic coefficient of variation, phenotypic coefficient of variation, heritability, genetic advance, correlation coefficient and path analysis are of great importance for selecting superior germplasm. The mean performance of growth characters revealed that JPL-31 was found to be the best in respect to growth parameters viz., leaf area (53.09cm<sup>2</sup>), leaf petiole length (5.70cm), catkin fresh weight (0.78g), catkin dry weight (0.30g), catkin fresh yield per plant (86.06g), catkin dry yield per plant (11.26g), and root dry weight (16.97g). Whereas, Viswam showed earliness for number of days from planting to catkin emergence (111.67), number of days from catkin emergence to maturity (63.00) and lower internodal length (4.62cm). With respect to genetic parameters catkin fresh weight, catkin dry weight, catkin girth, catkin fresh yield per plant, catkin dry yield per plant, vine length (plant height), number of catkins bearing per primary branch, days from planting to catkin emergence, days from catkin emergence to maturity, and chlorophyll content of leaves had high GCV and PCV. High heritability in broad sense was recorded in catkin chlorophyll content of leaves (98.20 %), vine length(plant height) (97.80 %), days from catkin emergence to maturity (97.20 %), fresh yield per plant (96.60), catkin dry weight (94.80 %), number of catkins bearing per primary branch (92.00 %), catkin girth (82.60 %), internodal length (81.10), catkin length (80.90 %), days from planting to catkin emergence (80.80 %), catkin dry yield per plant (80.10 %), root fresh weight per plant (75.50 %) and leaf area (69.00%). Chlorophyll content of leaves (114.29%), days from catkin emergence to maturity (109.63%), catkin dry weight (78.31%), vine length (plant height) (76.22%), days from planting to catkin emergence (72.53%), catkin fresh yield per plant (64.68%), catkin dry yield per plant (63.23%), number of catkins bearing per primary branch (51.52%), catkin girth (48,49%), catkin

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length (35.88%), catkin fresh weight (30.13%), internodal length (28.02%), leaf area (27.57%) and leaf petiole length (24.42%) showed high genetic advance as percent of mean where improvement in these characters which can be brought through simple selection programme. In correlation studies, leaf area, catkin fresh weight, catkin dry weight, catkin girth, catkin length, number of catkins bearing per primary branch, root dry weight, chlorophyll content of leaves, and catkin fresh yield per plant showed significant positive correlation with yield at both phenotypic and genotypic level suggesting good scope for improvement of yield. In Path coefficient analysis, number of catkins bearing per primary branch had highest positive direct effect (0.59) on catkin dry yield per plant followed by catkin fresh yield per plant (0.57), catkin length (0.30), leaf area (0.26) and days from catkin emergence to maturity (0.19). Whereas negative direct effect was executed by chlorophyll content of leaves (-0.40), days from planting to catkin emergence (-0.33), root dry weight per plant (-0.26), catkin dry weight (-0.23), internodal length (-0.15) and catkin girth (-0.14), respectively at genotypic level. The residual effect (0.24) indicated that sixteen characters studied in path analysis were contributing about 76.00 % of the variability in yield per plant.

## **Effect of Nano-Dap on Growth Yield and Nutrient Use Efficiency in Cabbage**

*Suchibrata Chamuah*

The present investigation entitled 'Effect of nano-DAP on growth, yield and nutrient use efficiency in cabbage' was conducted at the Experimental Farm, Department of Horticulture, A.A.U., Jorhat during 2021-2022. The experiment was laid out in Randomised Block Design with thirteen treatments and three replications. The treatments for the study were T1 (Untreated control), T2 (100 % recommended dose of N & K), T3 (100 % recommended dose of 130:80:80 kg/ha), T4 (T2 + Seedling root dip treatment @ 5 ml/ltr), T5 (T2 + Seedling root dip treatment @ 10 ml/ltr), T6 (T2 + 1 Foliar Spray of nano- DAP @ 6 ml/ltr at 25-30 DAT), T7 (50 % P, 100 % N & K + FS nano-DAP @ 2 ml/ltr at 25-30 DAT), T8 (25 % P, 100 % N& K + FS nano-DAP @ 4 ml/ltr at 25-30 DAT), T9 (T2 + ST @ 5 ml/ ltr + FS nano-DAP @ 6 ml/ltr at 25-30 DAT), T10 (25 % P, 100 % N & K + ST @ 5 ml/ ltr + FS nano-DAP @ 4 ml/ltr at 25-30 DAT), T11 (50 % P, 100 % N & K + ST @ 5 ml/ ltr + FS nano-DAP @ 2 ml/ltr at 25-30 DAT), T12 (25 % P, 50 % N & 100 % K + ST @ 5 ml/ ltr + FS nano-DAP @ 4 ml/ltr at 25-30 DAT) and T13 (50 % P, 50 % N & 100 % K + ST @ 5 ml/ ltr + FS nano-DAP @ 2 ml/ltr at 25-30 DAT). The growth and yield characters showed significant differences among the treatments. The maximum plant growth parameters, head weight, total yield and NPK uptake were recorded in T3 (100 % NPK). Application of nano-DAP as seedling root-dip treatment and foliar spray was found to be effective for plant growth and head yield of cabbage. Among the nano-treatments, better vegetative growth parameters were obtained in T7 (50 % P, 100 % N & K + Foliar spray of nano-DAP @ 2 ml/ltr at 25-30 DAT) while heavier heads (0.92 kg) and higher total yield (317.38 q/ha) was recorded in T9 (100 % N & K + seedling root dip @ 5 ml/ ltr + Foliar spray of nano-DAP @ 6 ml/ltr) which also registered maximum P uptake (10.23 kg/ha) by plants. The highest N (65.4 kg/ha) & K (103.63 kg/ha) uptake by cabbage plants was recorded in T11. Combination of 100 % N & K soil application + seedling root dip @ 5 ml/ ltr + Foliar spray of nano-DAP @ 6 ml/ltr (T9) was evaluated to be the most remunerative option with a Benefit: Cost ratio of 3.44 although a higher yield (317.38 q/ha) was obtained in T11 (50 % P, 100 % N & K + seedling root dip @ 5 ml/ ltr + Foliar spray of nano-DAP @ 2 ml/ltr). Recommended dose of 130:80:80 kg NPK/ha

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(T3) application resulted in the maximum head yield (348.60 q/ha) and B: C ratio (3.64). The use of nano-DAP may be a good alternative to minimise use of the conventional inorganic fertilizers thus reducing the cost on inputs, transportation & storage cost, mitigation of ground water pollution while sustaining the quality and quantity of produce.

## **Development of Whey Fortified Low-Fat containing Muffins**

*Sumedha Agarwal*

Muffins, among consumers, are one of the most favourite bakery products due to their soft texture and appreciable taste, and are also perfect for breakfast, brunch and as snacks. Such bakery commodities can serve as a suitable carrier of functional ingredients, targeted for reaching large population mass. In the present study, muffins were incorporated with whey protein concentrate (WPC) as a replacement of fat (T0 (0%), T1 (10%), T2 (30%), T3 (50%) and T4 (70%) (w/w) substitution), and the effect of such incorporation on the product's baking, physico-chemical and organoleptic properties were evaluated. T4 took the least baking time of 21.67 min as compared to T3 and T2 which baked within 25 min and 26.67 min respectively, while T1 and T0 baked needed duration of 31.67 min each, for attaining the same level of doneness. As a result of variation in composition and density amongst the treatments, difference in baking time was noted. Products with less density have faster rates of moisture diffusivity, leading to shorter baking time. Irrespective of the compositional variation, weight of the samples ranged within 45.33g to 47.29g per muffin, which showed no significant difference among the treatments ( $p > 0.05$ ). The height and volume of muffins showed an increasing trend. Height of WPC fortified muffins were greater than that of the control for all the levels of WPC incorporated. Volume was the lowest in T0 (70.50 cm<sup>3</sup>) and highest in T4 (98.33 cm<sup>3</sup>). Both height and volume showed significant differences among the treatments ( $p < 0.05$ ). These features were attributed to the strong emulsifying and foaming capabilities of whey protein, giving rise to escalated crumb structure. The latter reason can also explain the decreasing trend in density of the muffins with the increasing level of WPC; a net reduction of 13.96% in density of T4 was noted when compared with T0. Incorporation of air during batter mixing and creation of stable foam by whey protein probably resulted in less-dense (fluffy) crumb texture. This postulation is substantiated by the photographs of muffin's crumb having high amount of added whey protein, wherein large air vacuoles were observed. All the samples were organoleptically favourable (scores above the limit of acceptance) with a high preference for T2 and T3 over the other counterparts. Moisture content was highest in T0 (34.45%) and it decreased steadily with the increase in WPC level. The highest amount

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of crude protein and ash content were recorded in T4 (15.40g/100g and 1.59g/100g, respectively) due to the maximum addition of WPC in it. T0 recorded the highest percentages of crude fat (25.26g/100g). The highest calorific value was recorded in T0 (407.15 kcal/100g) and the lowest in T4 (299.62kcal/100g). A reduction of 69.36% in crude fat and an increase in 67.08% in protein content were observed from T0 to T4, and this improvement was credited to the increased amount of WPC as fat substitute. Thus, incorporation of WPC in muffins as 30% to 50% replacement of fat can improve the functional attributes of the final product, without compromising their sensory characteristics.

## Performance of new banana (*Musa* spp.) cultivars

*Sunny Gogoi*

The study on 'Performance of new banana (*Musa* spp.) cultivars' was conducted in the Experimental Farm, Department of Horticulture in Assam Agricultural University, Jorhat during 2019-2020. The experiment was laid out in Randomized Block Design (RBD) with five (5) treatments and four (4) replications. The treatments taken under the study comprised of five banana cultivars namely 'BRS Selection Popoulu', 'Manjeri Nendran-II', 'Nendran', 'NRCB Selection-10' and 'Simalu Manohar'. Experimental results revealed that the morphological characters showed significant differences among the cultivars. In regards to pseudostem height at shooting stage, highest height was recorded in 'Simalu Manohar' (312.70 cm) while the lowest was recorded in 'NRCB Selection-10' (203.91 cm). The highest pseudostem girth at shooting stage was recorded in 'Simalu Manohar' (77.58 cm). In respect to phyllochron, the longest days for successive leaf emergence was recorded in 'Simalu Manohar' (11.41 days) and the shortest was recorded in 'Manjeri Nendran- II' (8.60 days). The highest leaf area (1.17 m<sup>2</sup>) was recorded in 'Simalu Manohar' whereas the lowest in 'Nendran' (1.05 m<sup>2</sup>). 'NRCB Selection-10' recorded the highest number of leaves per plant at shooting (12.70) and the highest number of functional leaves at shooting (10.47). However 'Simalu Manohar' recorded the highest number of total leaves (24.53) and 'Manjeri Nendran-II' recorded the lowest (21.08). For shooting the shortest time was taken by 'Manjeri Nendran- II' (263.41 days) while 'Simalu Manohar' took the longest time (314.37 days). The shortest shootingharvesting duration was recorded in 'BRS Selection Popoulu' (59.75 days) while the longest was recorded in 'Simalu Manohar' (150.18 days). The shortest crop duration (350.35 days) was recorded in 'Manjeri Nendran-II' while the longest was recorded in 'Simalu Manohar' (464.56 days). Significant variation was noted among the varieties with respect to yield and yield attributing characters. The highest bunch weight was recorded in 'NRCB Selection-10' (12.73 kg) followed by 'BRS Selection Popoulu' (12.39 kg) while the lowest was recorded in 'Nendran' (7.03 kg). The highest fruit yield was found in 'NRCB Selection-10' (39.31 t/ha) followed by 'BRS Selection Popoulu' (38.25 t/ha) while the lowest fruit yield was recorded in 'Nendran' (21.70 t/ha). The highest number of hands per bunch (8.09) and fingers per hand (13.62) was recorded in 'NRCB

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Selection-10'. 'BRS Selection Popoulu' recorded the highest weight of second hand (2.29 kg) and finger weight (324.70 g). 'Manjeri Nendran-II' recorded the longest fingers (21.78 cm) and the lowest (12.85 cm) by 'BRS Selection Popoulu'. In regards to finger girth and finger diameter the highest value of 20.67 cm and 6.91 cm was recorded in 'BRS Selection Popoulu'. 'BRS Selection Popoulu' recorded the highest pulp weight (289.42 g) and pulp-peel ratio (8.22) whereas the highest peel weight was recorded by 'Simalu Manohar' (106.22 g). In regards to post harvest study and biochemical constituents significant variation was seen among the varieties. 'Nendran' recorded the highest value of TSS (28.92 0B) followed by 'NRCB Selection-10' (28.67 0B) while the lowest was recorded by 'BRS Selection Popoulu' (19.00 0B). The highest titrable acidity (0.49 %) and shelf life (6.50 days) was recorded by 'BRS Selection Popoulu' whereas the lowest titrable acidity (0.26 %) was recorded by 'Nendran' and the lowest shelf life (4.12 days) by 'NRCB Selection-10'. The highest reducing sugar (16.07 %) and total sugar (19.22 %) was recorded in 'Manjeri Nendran-II'. 'BRS Selection Popoulu' recorded the highest value (4.81 %) of non-reducing sugar. The highest value of crude fibre content (2.28 %) was recorded in 'BRS Selection Popoulu' and the lowest in 'Nendran' (1.09 %). Ascorbic acid was recorded highest in 'Nendran' (5.15 mg/100g FW) and the lowest in 'Simalu Manohar' (3.12 mg/100 g FW). Evaluation of comparative economics of cultivation revealed that the highest benefit cost ratio of 2.03 was obtained in 'NRCB Selection-10' followed by 'BRS Selection Popoulu' (1.94) and the lowest benefit cost ratio of 0.67 was recorded in 'Nendran'. Hence, among all the cultivars 'NRCB Selection-10' and 'BRS Selection Popoulu' were found to be the most profitable and suitable cultivars for cultivation.

## **Active Packaging For The Enhancement of Shelf Life In Strawberry (*Fragaria x ananassa* Duch.)**

*Swarup Anand Dutta*

A lab experiment was conducted in Laboratory, Department of Horticulture, AAU, Jorhat during 2021 with a view to enhance the shelf life of strawberry (*Fragaria x ananassa* Duch.) by various treatments under active packaging system. Two packaging system, plastic packaging (P1) and CFB packaging (P2) were used. The experiment was laid out in Factorial Randomized Block Design (RBD) with eight treatments viz. T1 (Oxygen absorber + Chlorine dioxide (5ppm), T2 (T1 + Moisture Absorber), T3 (Ethylene absorber + Chlorine dioxide (5ppm), T4 (Ethylene absorber + Moisture absorber + ClO<sub>2</sub> (5ppm)), T5 (Chitosan 1% + Lemon essential oil), T6 (Chitosan 1% + Potassium sorbate (0.3%)), T7 (Hexanol (as vapour), T0 (Control (Without treatment) with three replications. The results revealed that both the packaging materials and the treatments had a significant impact in boosting up the shelf life of strawberry along with the quality parameters. The observations revealed that shelf life was found to be highest in T4 (8.33 days in T4P1 and 8.66 days in T4P2), Physiological loss in weight (PLW) was lowest in T5 (3.80 % in T5P1 and 3.14% in T4P2), Decay incidence was lowest in T7 (36.66% in P1T7 and 31.33% in P2T7). Under sensory evaluation, significant results were obtained in P1 for colour, taste, texture and flavor. (Colour- 9.00 in T4, Taste- 8.66 in T7, Texture- 8.66 in T7, Flavour- 8.66 in T4). For quality parameters, maximum TSS was obtained in T6P1(11.36oBrix), TA was found to be higher in T4P2 (0.91%) and T6P1 (0.91%), Anthocyanin was recorded highest in T5 (62.26 mg/100g in P1 and 63.23 mg/100g in P2), Ascorbic acid was found to be highest in T4P1 (72.33mg/100g), Total antioxidant was highest in T4 (89.13% in P1 and 88.62% in P2) and total sugar was found to be highest in T4 (6.90% in P1 and 6.81% in P2) in the second day of packaging. On the fourth day, maximum TSS obtained in T4P2 (12oBrix) and T6P1(11.90oBrix), TA was found to be higher in T4P2 (0.79%) and T6P1 (0.79%), Anthocyanin was recorded highest in T5 (65.63 mg/100g in P1 and 64.80 mg/100g in P2), Ascorbic acid was found to be highest in T4P1 (73.63mg/100g), Total antioxidant was highest in T4 (85.59% in P1 and 84.58% in P2) and total sugar was found to be highest in T4 (6.53% in P1 and 6.42% in P2). On the sixth day, maximum TSS obtained in T4P2 (11.76oBrix) and T6P1 (11.6 oBrix), TA was found to be higher in T6P1

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(0.61%), Anthocyanin was recorded highest in T5 (65.0 mg/100g in P1 and 63.46 mg/100g in P2), Ascorbic acid was found to be highest in T4P1 (71.50mg/100g), Total antioxidant was highest in T4 (76.94% in P1) and total sugar was found to be highest in T4 (6.13% in P1 and 6.14% in P2). The benefit cost ratio indicated superiority of treatment T4 with a ratio of 1.42. On the basis of the result obtained in the present investigation, T4 (Ethylene absorber + Moisture absorber + chlorine dioxide) which performed best in boosting up the shelf life and quality of strawberry can be suggested for further studies for recommendation. CFB packaging performed better than plastic packaging in the entire experiment.

## Organic Nutrient Management in Amaranthus

*Swati Sulagna Sarangi*

The present investigation was conducted in the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat during Summer, 2022 to assess the impact of organic nutrients on productivity traits and quality of amaranth. The experimentation was in randomized block design (RBD) which consisted of eleven treatments replicated thrice. The treatments taken were T<sub>1</sub>: RDF (60:30:20 kg NPK/ha), T<sub>2</sub>: Vermicompost @ 2 t/ha, T<sub>3</sub>: Vermicompost @ 5 t/ha, T<sub>4</sub>: FYM 10 t/ha, T<sub>5</sub>: FYM 20 t/ha, T<sub>6</sub>: Poultry manure 3 t/ha, T<sub>7</sub>: Poultry manure 5 t/ha, T<sub>8</sub>: Vermicompost @ 2 t/ha+PSB+*Azospirillum* @ 5 kg/ha each, T<sub>9</sub>: FYM @ 10 t/ha+ PSB+ *Azospirillum* @ 5 kg/ha each, T<sub>10</sub>: Poultry manure 3 t/ha+ PSB+ *Azospirillum* @ 5 kg/ha each and T<sub>11</sub>: Untreated control. The study revealed that there were significant differences in morphological characters among the treatments. Maximum plant height was observed in the treatment T<sub>8</sub> (28.24cm, 52.14cm and 55.84cm) at 30 DAS, 45 DAS and at harvest, respectively. The maximum plant width viz., 22.21cm, 24.76cm, 26.55cm was exhibited by the treatment T<sub>8</sub> (Vermicompost @ 2t/ha+PSB+*Azospirillum* @ 5 kg/ha each) at 30 DAS, 45 DAS and at harvest, respectively and were at par with treatment T<sub>1</sub>. Minimum plant height and plant width were observed in the treatment T<sub>11</sub>. The leaves per plant at harvest (31.26) were the highest in the treatment T<sub>1</sub>. Among the organic treatments maximum number of leaves (26.88) was observed in the treatment T<sub>8</sub>. The maximum fresh weight (1.19g) as well as dry weight (0.25g) of individual leaf was recorded in the treatment T<sub>8</sub>. Maximum number of days (56) for harvest was observed in the treatment T<sub>6</sub>. Maximum fresh weight of leaves (32g/plant) and maximum fresh weight of stems (57g/plant) were observed in the treatment T<sub>8</sub> and T<sub>10</sub>. The maximum plant weight (88g/plant) was recorded in T<sub>8</sub> while the lowest (43.1g/plant) was observed in T<sub>11</sub>. Maximum stem girth (2.6cm) and the highest number of branches (7.5) were recorded in the treatment T<sub>8</sub>. Maximum leaf to stem ratio (0.60) was exhibited by the treatment T<sub>1</sub> which was followed by the treatment T<sub>8</sub> (0.57). The highest leaf yield (2.86kg/plot and 71.6q/ha) was recorded by the treatment T<sub>8</sub> while the highest stem yield (5.12kg/plot and 127.9q/ha) was observed in T<sub>10</sub>. Total crop yield was the highest (7.92kg/plot and 198.0q/ha) in the treatment T<sub>8</sub>. The highest vitamin C (147.8 mg/100 gm) and crude fibre content (1.48%) was observed in the treatment T<sub>8</sub> (FYM 10t/ha) and T<sub>4</sub>. Maximum

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calcium (8.36%) and iron (0.21%) content was observed in the treatment T<sub>8</sub>. The treatment T<sub>10</sub> (Poultry manure 3t/ha+ PSB+ *Azospirillum* @ 5 kg/ha each) recorded the highest mean performance for P H , organic carbon, available nitrogen and potash content in the soil analyzed after harvest of the crop. Maximum available phosphorus was exhibited by the treatment T<sub>8</sub>. The highest net return (Rs.226421.00) was obtained in the treatment T<sub>1</sub> (RDF: 60:30:20 kg NPK/ha) with a benefit-cost ratio of 3.8. Among the organic treatments the maximum benefit-cost ratio (3.1) was obtained in the treatments T<sub>9</sub> and T<sub>10</sub> due to lower price of FYM and poultry manure as compared to the price of vermicompost.

## **Diversity and Abundance of Plant Parasitic Nematodes Associated with Vegetable Crops at Jorhat District of Assam**

*Arkadeb Chatterjee*

Investigations were carried out to know the diversity of plant parasitic nematodes associated with vegetable crops in Jorhat district of Assam and to study their community structure of various plant parasitic nematodes around the rhizosphere of vegetable crops. A total of one hundred and forty-six soil as well as root samples were collected from thirty-nine different vegetable crops from five administrative block of Jorhat district. Survey of plant parasitic nematodes revealed that eight species of plant parasitic nematodes belonging to eight genera were associated with the vegetable crops of Jorhat district. The species of plant parasitic nematodes recorded were viz., *Meloidogyne incognita*, *Helicotylenchus dihystra*, *Rotylenchulus reniformis*, *Macroposthonia onostris*, *Hoplolaimus indicus*, *Scutellonema brachyurus*, *Tylenchorhynchus annulatus* and *Xiphinema radicum*. Community analysis of plant parasitic nematodes around the rhizosphere of vegetable crops in Jorhat district revealed that *Meloidogyne incognita* ranked first in absolute frequency, relative frequency, absolute density, relative density and prominence value. *Helicotylenchus dihystra* ranked second in absolute density, relative density and prominence value; third in absolute frequency and relative frequency. *Rotylenchulus reniformis* ranked third in absolute density, relative density and prominence value; third in absolute frequency and relative frequency. *Macroposthonia onostris* being fourth in absolute frequency, relative frequency, absolute density, relative density and prominence value. *Hoplolaimus indicus* is in the fifth position in terms of absolute frequency, relative frequency, absolute density, relative density and prominence value. *Scutellonema brachyurus* is in the sixth position when absolute frequency, relative frequency, absolute density, relative density and prominence value are considered. *Tylenchorhynchus annulatus* holds the seventh position in terms of absolute frequency, relative frequency, absolute density, relative density and prominence value. *Xiphinema radicum* holds the eighth position in terms of absolute frequency, relative frequency, absolute density, relative density and prominence value.

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prominence value. Soil temperature, soil moisture content percent and rainfall was found to be closely related to the nematode population fluctuations. The increase in temperature and soil moisture content percent was associated with the increase in nematode population within the range of favourable condition which is in between 15.5°C - 28.0°C (ideally around 25°C); with a soil moisture level of 15.0 – 22.0 percent and monthly rainfall of 0.6 – 302.2 mm

## **Screening and Management of Root-knot Nematode, *Meloidogyne incognita* in Okra**

*Kangkan Patiri*

In the present study on screening of okra varieties against root-knot nematode, *Meloidogyne incognita*, all the eleven varieties of okra showed susceptibility against *M. incognita* namely “Green Star”, “Nishita”, “S-51”, “Rani”, “Basanti”, “S56”, “Solar-600”, “Selection-51”, “SC-18”, “Super Green” and “Kohinoor”. Studies on the efficacy of *Glomus fasciculatum*, Org-Trichojal, Neem oil cake and Carbofuran 3G in the management of *M. incognita* in okra under field condition showed that all the treatments were effective in increasing the plant growth parameters and yield of okra. The treatment *G. fasciculatum*@300spores/m<sup>2</sup>+OrgTrichojal-20ml/0.5kg of vermicompost + Neem oil cake @1.25t/ha was found to be the best in increasing plant growth parameters and yield of okra. The treatment with *G. fasciculatum* @300spores/m<sup>2</sup> +Org-Trichojal @ 20ml/0.5kg + Neem oil cake @ 1.25t/ha was found to be the best treatment in reducing the root-knot index followed by the treatments with *G. fasciculatum*@300spores/m<sup>2</sup> + Org-Trichojal-20ml/0.5kg of vermicompost and Org-Trichojal-40ml/kg of vermicompost. Further, it was observed that the treatment with *G. fasciculatum* @300spores/m<sup>2</sup> +Org-Trichojal @ 20ml/0.5kg + Neem oil cake @ 1.25t/ha was found to be effective in suppressing of final nematode population in the soil.

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**Major Adviser: Dr. B. Mahanta**

## **Pathogenicity and Management of Reniform Nematode (*Rotylenchulus reniformis* Linford & Oliveira, 1940) on Cowpea (*Vigna unguiculata*)**

*Kshetrimayum Ria*

Studies on the pathogenicity of reniform nematode (*Rotylenchulus reniformis* Linford & Oliveira, 1940) on cowpea (*Vigna unguiculata*) showed that there was a progressive decrease in the plant growth parameters as the inoculum level of *Rotylenchulus reniformis* increased, i.e., 10, 100, 500, 1000, 5000, and 10,000 nematodes per pot. An initial inoculum level of 1000 nematodes per pot caused a significant reduction in shoot length, shoot and root weight and proved to be pathogenic to cowpea (var. local). There was a gradual increase in the number of females, egg masses per root system, and nematode population of *Rotylenchulus reniformis* in the pot as the inoculum level increased. The reproductive rates were found to be inversely proportional with inoculum levels, with the highest at 100 and the lowest at 10,000 nematodes per pot. On the basis of these results, it can be concluded that the threshold level of reniform nematode, *Rotylenchulus reniformis* was 1000 nematodes per pot. Investigations were carried out to evaluate the efficacy of different bio-control agents viz., Bioveer, Biozium, Biomonas, Biofor-PF2 and Biozin-PTB for the management of reniform nematode *Rotylenchulus reniformis* on cowpea (var. local) under net house conditions. All the treatments increased the plant growth parameters and reduced the number of females, egg masses per root system, and nematode population in the pot compared to the untreated control. Among all the treatments, the best results were observed in the treatment with Biozin-PTB enriched in decomposed cow dung @ 10 % w/w with a maximum decrease in the number of females (13.66) followed by Biofor-PF2 (16.66) and Biozium (20.00), wherein untreated control the number of females per root system was found to be (48.33). These treatments were found to significantly improve the plant growth parameters of cowpea and reduce the nematode population of *Rotylenchulus reniformis*.

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**Department: Nematology**

**Major Adviser: Dr. Gitanjali Devi**

## **Approaches for management of *Meloidogyne incognita* in Pulse crops**

*Maria Zonunpui*

Investigation were carried out under Net House condition to evaluate the reaction of eight chickpea germplasm, ten pea germplasm and forty six lentil germplasm along with their respective susceptible checks for resistance against *Meloidogyne incognita*. All eight germplasm of chickpea screened were found to be either susceptible or highly susceptible to *M. incognita*. None of the germplasm were found to be resistant to *M. incognita*. Among ten germplasm of pea, two germplasm viz., IPFD-99-13 and IPFD-12-2 were found to be resistant, two germplasm were found to be moderately resistant, and the rest six germplasm were found to be either susceptible or highly susceptible. Out of forty six lentil germplasm screened, only one germplasm (IPL 81) was found to be resistant, seven germplasm were found to be moderately resistant, while the rest thirty eight germplasm were found to be either susceptible or highly susceptible to *M. incognita*. Study on the bio-intensive management of *M. incognita* on black gram with bio-agents viz., *Bacillus marisflavi*, *Bacillus altitudinis*, *Bacillus subtilis*, *Trichoderma viride*, *Verticillium lecanii* and *Pseudomonas fluorescens* showed significant increase in plant growth parameters including root nodulation with corresponding decrease in number of galls per root system, egg masses per root system, and final nematode population over untreated control. The treatment with soil application of *Pseudomonas fluorescens* @ 1x10<sup>8</sup> cfu/ml enriched in vermicompost @ 20 g/m<sup>2</sup> was found to be the most effective in enhancing plant growth parameters, number of nodules per root system and reducing number of galls per root system, egg masses per root system and final root-knot nematode population in soil. Nonetheless, all the treatments significantly decreased number of galls, egg masses and final nematode population in soil.

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**Department: Nematology**

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## **A temporal assessment of nematode community structure in spice crops**

*Mitu Baishya*

Present study is carried out to know the distribution and community structure of nematode associated with five different spice crops from five districts of Assam. Soil samples were collected from five districts of Assam (viz., Jorhat, Nagaon, Golaghat, Nalbari and Karbi Anglong). Survey of free living as well as plant parasitic nematodes revealed that nine genera were found to be associated with the spice crops in these regions. Nine genera recorded were *Tylenchorhynchus* sp, *Hoplolaimus* sp, *Helicotylenchus* spp, *Meloidogyne* sp., *Xiphinema* sp., *Mononchoides* sp., *Rhabditis* sp., *Cephalenchus* sp. and *Dorylaimoides* sp.

Community analysis of nematodes revealed that in free living nematodes *Cephalenchus* sp. ranked first in having the highest absolute frequency of 95.00% and prominence value of 43.74 in Ginger (*Zingiber officinale*). *Mononchoides* sp. have the highest relative frequency of 16.30%, *Cephalenchus* sp. have the highest absolute density of 372.40% and relative density of 36.28% in Turmeric (*Curcuma longa* ). In Black pepper (*Piper nigrum*), *Mononchida* spp. ranked first with relative frequency of 16.30%. Among plant parasitic nematodes *Hoplolaimus* sp. has the highest absolute frequency of 87.50% in Curry leaves (*Murraya koenigii*) and relative frequency of 14.13% in Turmeric (*Curcuma longa*). Coriander (*Coriandrum sativum*) has an absolute density, relative density and prominence value of 292.00%, 24.38% and 25.29, respectively in *Tylenchorhynchus* sp.

During the correlation study of the total nematode population with that of the soil physio-chemical properties in the spice crops, it was found that the pH showed significant negative correlation with the total nematode count while the available nitrogen, available potassium, organic carbon and organic matter was positively correlated with the total nematode population found in the soil.

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**Abstract of M.Sc. thesis**

**Department: Nematology**

**Major Adviser: Dr. Nibedita Borgohain**

## **Grafting for the management of root knot nematode, *Meloidogyne incognita* in brinjal**

*Polimera Prasanth*

An attempt was made for the management of root knot nematode, *Meloidogyne incognita* in brinjal through grafting. Thirteen *Solanum* species were screened against *M. incognita*. Of these, *S. torvum* and *S. khasianum* showed resistant and moderately resistant reactions against *M. incognita* and remaining species showed highly susceptible reactions against *M. incognita*. *S. torvum* and *S. khasianum* were taken as rootstocks. Liliya and Kokila were taken as scions. Highly susceptible and cultivated hybrids, Liliya and Kokila were grafted on resistant rootstock *S. torvum* and on moderately resistant rootstock *S. khasianum*. Cleft grafting method was adopted for grafting. The highest success rate of grafting was recorded on *S. torvum* × Liliya, followed by *S. torvum* × Kokila. Liliya and Kokila grafted on *S. torvum* showed maximum reduction in number of galls, egg masses per root system, final nematode population and rate of reproduction with increased number of fruits per plant, fruit weight, fruit yield per plot and total fruit yield per ha followed by Liliya and Kokila grafted on *S. khasianum*. Delayed flowering and fruiting was observed in grafted plants as compared to non grafted plants.

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**Abstract of M.Sc. thesis**

**Department: Nematology**

**Major Adviser: Dr. Bhabesh Bhagawati**

## **Phenotypic Characterization of Photoperiod Insensitive Joha Rice Mutants under Post Flood Transplanted Situation**

Joha rice of Assam is a unique specialty class, highly in demand for its taste, palatability and aroma. Joha rice requires genetic modifications for its successful cultivation in different seasons. Therefore, the present investigation comprised twelve photoperiod insensitive mutants and the parent Kon Joha and Disang as checks evaluated for 16 morpho-agronomic traits under two planting densities (15x10cm & 20x10cm) in randomized block designs with three replications, under post-flood transplanted situations. Analyses of variance (ANOVA) revealed significant genotypic variations for days to maturity, plant height, culm length, panicle length, filled grains, spikelet fertility, 1000- grain weights, and grain yield (per hill & ha) in both the planting densities. Chaff per panicle showed significant differences among the genotypes under sparse planting, while the genotypic variation for average panicle weight and harvest index was substantial in the densely planted crop. Pooled ANOVA indicated significant genotypic variations for all the traits except days to 50% flowering, productive tillers and biological yield. The genotypes showed differential responses to planting densities for chaff per panicle and harvest index. Thus, there is scope for selecting genotypes with higher spikelet fertility and greater harvest index, corroborated by significant negative correlations of chaff number with grain yield and harvest index; the latter two have a strong association. The sparsely planted crop was significantly superior to the dense planting for plant height, culm length, panicle length, 1000-grain weights and grain yield. Thousand-grain weights showed moderate genetic variability, high heritability, and high genetic advance under sparse planting. Grain yield per hill accorded high genetic variability, moderate heritability, and high genetic advance. At the same time, these parameters were all high for harvest index, suggesting a significant role of additive gene action. A strong positive correlation between harvest index and grain yield and a high positive direct effect of the former on the latter asserted the proposition of simple selection to improve upon grain yield under late sown/transplanted conditions.

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**Major Adviser: Dr. Debojit Sarma**

The yield correlations of spikelet fertility and biological yield were also sizable, along with considerable direct effects, suggesting their importance in yield improvement under the late Sali post-flood transplanted situation. Wider spacing of 20x10cm maximizes trait expression and yield selection for post-flood situations. Kon Joha mutants, KJM 250-22-17-125 and KJM 250-22-17-40, with grain yield comparable to Disang, can be tested over locations under such conditions. The study further emphasized the importance of mutation breeding in generating desirable agronomic changes in Joha rice, keeping aroma and quality intact.

# **Performance of Some Rice (*Oryza sativa* L.) Genotypes in Direct Seeding and Transplanting for Grain Quality Characters**

*Bidisha Bhattacharya*

Rice (*Oryza sativa* L.) is the second most important staple food crop. Every year, new rice varieties with higher yield potential and better resistance to biotic and abiotic stresses have been released continuously for six decades. However, in the breeding programmes, the grain quality is often not considered, so the varieties do not gain popularity. Rice grain quality plays a vital role in determining consumer preference and marketability. Besides having substantial human consumption demand, high-quality rice also has tremendous export potential. Rice quality envelops milling, cooking, eating and nutritional quality of the grains. One of the effective traditional methods of rice cultivation is manual transplanting. However, farmers' friendly and labour-effective direct seeding method is a better alternative to transplanting for sustainable and cost-effective agriculture. The quality of rice grain should remain unchanged in different methods of cultivation. In the current trend for high-quality grains, rice improvement works should focus on this aspect. This study is therefore essential to determine the effect and the changes in the grain quality traits of different rice varieties due to varying cultivation methods, i.e., direct-seeding and transplanting. The present study evaluated ten rice genotypes grown under transplanted and directseeded cultivation methods for genetic variability based on seven quantitative, nine grain-quality, eight biochemical and two qualitative characters. The analysis of variance revealed significant variation for all the traits except head rice recovery % under both methods of establishment. Pooled analysis revealed significant GxE interactions for grain length, shape, and milling %. Significant variation due to environment was observed for days to 50% flowering, days to maturity, ear-bearing tillers per plant, grain yield per hectare, grain breadth, crude protein, amylose, amylopectin, crude fat, ash, iron and zinc content and significant variation among the genotypes was reported for all the characters except milling % and head rice recovery %. For most of the characters, higher mean values were reported under the transplanted cultivation method, indicating the better performance of the genotypes under transplanted conditions than the direct-seeded one. From the pooled

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**Department: Plant Breeding and Genetics**

**Major Adviser: Dr. Kishore Kumar Sharma**

mean performances of the genotypes, Lachit, IR-64, and Dholi were the best genotypes concerning quantitative, grain-quality and biochemical characters, respectively. From the pooled analysis, high estimates of GCV and PCV were observed for grain yield per hectare, crude fat, ash, iron and zinc content, indicating ample scope for improvement of these characters. Heritability and genetic advance were high for plant height, earbearing tillers per plant, grains per panicle, one-thousand-grain weight, grain yield per hectare, grain shape, kernel shape, crude protein, crude fat, ash, iron and zinc content which indicates additive-gene action govern these characters. This will facilitate the improvement of grain quality in self-pollinated crops like rice through simple selection methods. Kernel length and hulling % showed significant positive correlations with grain yield per hectare. Grain length, grain shape, kernel length and kernel shape exhibited strong positive correlations amongst each other whereas, iron and zinc contents of the grains were negatively correlated with hulling (%).

# **Hereditary Variation and Dna Fingerprinting in Cross Derivatives of Indica and Japonica Rice (*Oryza sativa* L.)**

*Bijayalaxmi Maharana*

The present investigation was undertaken at Assam Agricultural University, Jorhat in randomized block design with three replications during Sali, 2021 for studying the hereditary variation, determining correlations and path coefficients and performing DNA fingerprinting in rice genotypes. The materials comprised of seven F8 lines, two parents viz, IR 68888B and Kmj 13S-3-1-3, and two check varieties viz., Ranjit and Numoli for the field evaluation. Eighteen quantitative and ten qualitative traits were considered. Analysis of variance revealed significant to highly significant mean squares for the quantitative traits. Average panicle weight, biological yield per hill, grain yield per hill and grain yield per hectare showed high values of genotypic coefficient of variation, phenotypic coefficient of variation, heritability, and genetic advance as percent of mean. Simple selection method would be efficient to improve plants for these traits. The three entries viz., (Kmj 13S-3-1-3/IRGC 30398)-6, Ranjit and (IR 68888A/Kmj 13S3-1-3)-1 had the highest yield among all the genotypes and these also showed superior mean performances for few other productivity traits. Association studies revealed that days to heading, days to 50% flowering, plant height, culm length, filled grains per panicle, biological yield per hill, and grain yield per hill had positive and significant phenotypic as well as genotypic correlation with grain yield per hectare. Characters viz., decorticated grain length, biological yield per hill and filled grains per panicle had large and positive direct effects on grain yield per hectare. A total of 30 SSR markers selected from Gramene website were used to fingerprint the lines under study. Out of these, 12 SSRs showed polymorphism among the parents. The SSR marker profiling suggested the existence of diversity among the entries with PIC ranging from 0.1597 (RM218) to 0.7083 (RM19). Similarity matrix values ranging from 0.125 to 0.647 was used to construct the dendrogram. The genotypes were segregated into three clusters based on dendrogram. Cluster 1 consisted of five genotypes viz., IR 68888B, Kmj 13S-3-1-3, Ranjit, (Kmj 13S3-1-3/IRGC 30398)-6 and (IR 68888A/Kmj 13S-3-1-

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3)-1 while, Cluster 2 was formed with (Kmj 13S-3-1-3/IRGC 30398)-5, IRGC 30398, (Kmj 13S-3-1-3/IRGC 30398)-3 and Numoli. Cluster 3 involved the following three genotypes namely, (Kmj 13S-3-1-3/IRGC 30398)-1, (Kmj 13S-3-1-3/IRGC 30398)-2 and (IR 68888A/Kmj 13S-3-1-3)-4.



## **Extent of Genetic Variation and Correlation Studies in Okra (*Abelmoschus esculentus* L. Moench)**

*Biswajit Kaman*

The present investigation was executed to study variability, heritability, genetic advance, correlation coefficient, direct and indirect effects of interrelated characters among the 28 okra genotypes at Horticulture experimental farm, Assam Agricultural University, Jorhat during the Summer season of 2021. Analysis of variance revealed that substantial genetic variation was present among the genotypes for each observed character. In view of the mean performance the genotype G-27 exhibited highest fruit yield per plant. It was however followed by G-26, G-25 and G-28. High genotypic and phenotypic coefficient of variation was recorded for the number of fruits per plant, fruit length, fruit diameter, internode length, fruit weight, number of seed per fruit, seed yield per fruit, and fruit yield per plant, which indicates the existence of the broad genetic base. Hence it would be amenable for further selection. High heritability was estimated for fruit length, fruit diameter, leaf blade length, leaf blade width, number of fruits per plant, number of branches per plant, seed yield per fruit, and fruit yield per plant. High heritability accompanied with high genetic advance was observed for fruit length, fruit diameter, number of fruits per plant, fruit weight, and number of branches per plant, seed yield per plant, and fruit yield per plant suggesting that these characters can be improved through direct selection since these characters are controlled by additive gene action. The correlation coefficient revealed that fruit yield per plant was found to be positively correlated with fruit length, internode length, number of fruits per plant, hundred seed weight, and seed yield per fruit at both phenotypic and genotypic levels. Fruit yield per plant was also found to be positively correlated with plant height at the genotypic level. Hence genetic improvement of fruit yield can be obtained by direct selection of these independent component traits. Genotypic correlation also revealed a positive association among the desirable traits such as fruit diameter with fruit weight, Fruit diameter with the number of seeds per fruit, fruit length with the number of fruits per plant, days to 50% flowering with days to 50% edible fruit harvest. Hence selection for such positively associated characters could help the direct improvement of yield.

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Path coefficient revealed that characters namely fruit length, plant height, number of fruits per plant, first flowering node number, hundred seed weight, and number of seed per fruit showed positive direct effects on yield. So direct selection of such characters will be effective for further yield improvement.

## **Morphological Characterization of M<sub>4</sub> and M<sub>5</sub> Micromutants in Black Gram [*Vigna mungo* (L.) Hepper]**

*Bonani Kakoty*

Black gram [*Vigna mungo* (L.) Hepper] is one of the important proteinaceous pulse crop grown throughout India. The present investigation was conducted during kharif-2021 and summer-2022 in Assam Agricultural University to examine seven mutant genotypes along with one check (SBC-40) to evaluate genetic variation and morphological characterization for yield and its component traits of blackgram. Three replications of the experiment were set up in a randomized block design. Analysis of variance revealed highly significant genetic variation among the eight urdbean mutant genotypes for all the characters in both M<sub>4</sub> and M<sub>5</sub> generations. In the M<sub>4</sub> generation, a high genotypic and phenotypic coefficient of variation was apparent for clusters per plant. In case of M<sub>5</sub> generation none of the traits showed high genotypic and phenotypic coefficient of variation but branches, clusters and pods per plant, 100 seed weight, single plant yield and seed yield per hectare showed a moderate coefficient of variation. The high heritability and genetic advance was observed for branches and clusters per plant and pods per cluster in both generations indicate predominance of additive gene action in the inheritance of the trait. Seed yield per plant exhibited a strong significant positive connection with branches and clusters per plant, plant height, seeds per pod, and pod length in the M<sub>4</sub> generation and with clusters per plant and pod length in the M<sub>5</sub> generation at both the genotypic and phenotypic levels. Path analysis revealed maximum direct and positive effect on seed yield per plant by seeds per pod and clusters per plant at genotypic level and by branches per plant and clusters per plant at phenotypic level. The genotypes BGM-250-10-1 and BGM-02-11- 1 were found to be consistent in both generations on the basis of their yield and component characters. Thus, the present findings could be beneficial in generating desirable traits to develop superior genotypes through selection in black gram breeding programme.

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**Abstract of M.Sc. thesis**

**Department: Plant Breeding and Genetics**

**Major Adviser: Dr. Akashi Sarma**

# **Morpho-Chemical Evaluation and DNA Fingerprinting of Advanced Generation Lines of Pigmented Rice**

*Chinmaya Bishoyi*

Rice is the most important cereal across the world and plays a vital role in reducing global hunger. But white rice is nutritionally poor and has a high glycemic index. So, currently, consumer preference has shifted to nutritionally enriched rice. Pigmented rice or coloured rice has numerous health benefits derived from pigmented rice which contains bioactive compounds like anthocyanins, phenols, dietary fibres, minerals, and vitamin B1 and B2 which is higher in comparison to white rice. The traditional black rice is a low yielder containing 10-13% amylose and has a low head rice recovery of less than 30% and requires a higher cooking time of around 1 hour. The present research aims at to evaluate the advanced generation lines of pigmented rice of the cross (Maniki maduri X Bahadur) X Black rice. The 15 F9 lines were grown in RBD with 3 replications and 4 check varieties i.e.; Ranjit, Keteki joha, Upendra rice and Manipuri rice. Study of analysis of variance revealed that there was significant difference for all the morphological traits. The number of grain yield per plant showed high GCV, and PCV along with high heritability and genetic advance percentage of mean. So, selection for this trait can be rewarding. The lines AAU TTB Pigmented Dhan-7, AAU TTB Pigmented Dhan-8, AAU TTB Pigmented Dhan-13, AAU TTB Pigmented Dhan-14, AAU TTB Pigmented Dhan-15 had similar number of number of tillers per plant and number of panicles per plant statistically with Ranjit. The lines AAU TTB Pigmented Dhan-3, AAU TTB Pigmented Dhan-5, AAU TTB Pigmented Dhan-7, AAU TTB Pigmented Dhan-11, AAU TTB Pigmented Dhan-12, AAU TTB Pigmented Dhan-13 were found to have grain yield per plant statistically at par with Ranjit. The nutritional analysis showed that the lines AAU TTB Pigmented Dhan-4, AAU TTB Pigmented Dhan-7, AAU TTB Pigmented Dhan-9 and AAU TTB Pigmented Dhan-15 showed better performance in terms of total flavonoid content, total phenol content, DPPH radical scavenging activity and the lines AAU TTB Pigmented Dhan-4, AAU TTB Pigmented Dhan-7, AAU TTB Pigmented Dhan-8, AAU TTB Pigmented Dhan-9, AAU TTB Pigmented Dhan-13, AAU TTB Pigmented Dhan-14 showing

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amylose percentage close to 20%. AAU TTB Pigmented Dhan-9 was having highest amount of iron both in unpolished (27.7ppm) and polished form (11.9 ppm) respectively. Highest zinc content was observed in AAU TTB Pigmented Dhan-5 in unpolished form (35.8 ppm) but in polished form Keteki joha had highest zinc content (27.18 ppm). It was also observed that the loss of iron content due to polishing was more than zinc content. The gelatinization temperature of almost all of the lines was high. DNA fingerprinting was done with the help of 50 SSR panel markers selected from Gramene, out of which 7 markers showed polymorphism for the parents. The PIC content of the F9 progenies varied from 0.377 (RM283) to 0.715 (RM11) suggesting that existence of diversity. The dendrogram was made based on evolutionary coefficient of dissimilarity which was ranging from 0.11 to 1. The highest dissimilarity was observed between Upendra rice and Keteki Joha, lowest was noticed between AAU TTB Pigmented Dhan-2 and AAU TTB Pigmented Dhan-5. The dendrogram grouped the genotypes into two clusters and Keteki joha is outliered. Cluster 1.A days to 50% flowering, days to maturity showed similar values except AAU TTB Pigmented Dhan-14. Plant height were similar except Manipuri rice. Cluster 2.A number of grains per panicle and grain yield per plant had similar values and plant height were having similar values except AAU TTB Pigmented Dhan-11. In cluster 2.B Ranjit and AAU TTB Pigmented Dhan-7 showed similar values for plant height, number of tillers per plant, number of panicles per plant, thousand grain weight and grain length. Among F9 lines AAU TTB Pigmented Dhan-4 and AAU TTB Pigmented Dhan-7 have shown superior morpho-chemical performance and can be considered as best two lines. These lines could be commercialized in future.

## **Economic Analysis of Silk Weaving in Assam**

*Dikprachurjya Bharali*

The present study on “Economic Analysis of Silk Weaving in Assam” was undertaken with specific objectives viz., study the status of weaving industry in Assam, analyze the economic feasibility of silk weaving and identify the problems faced in silk weaving. The present study was conducted in Sualkuchi area in Kamrup district of Assam. The study was based on primary as well as secondary data. Pre-tested schedule was used to substantiate the second and third objectives of the study, whereas secondary data from numerous sources like All India Handloom Censuses, Statistical Handbook of Assam etc. were used to substantiate the first objective. For analyzing the economic feasibility as well as to identify the problems faced by the weavers, primary data pertaining to the year 2019-20 were collected through random sampling technique from the household of the weavers of Sualkuchi. For this purpose, samples of 100 weavers’ household were randomly selected, after that they were being classified into four groups based on their loom size. The results of the study reveal that the majority of the population under the study was mainly engaged with silk weaving and only a small portion with agriculture. The growth rates in case of total invested capital, total output value of weaving industry, number of trainees in Handloom Training Centre (HTC) and Weavers Extension Service Production of Assam were positive and significant, while it was found to be negative and significant for handloom production from Handloom Production Centre (HPC). The number of handloom weavers in Assam showed a increasing trend from Second All India Handloom Census to Third and Fourth All India Handloom. However, a decreasing trend was observed in case number of handloom units in Assam. It was observed that silk weaving was highly cost and labour intensive enterprise. Based on the analysis it was found that out of the total cost, the highest cost incurred was for yarn and dye which were considered to be the most important variable input of weaving. The total annual cost per loom was Rs. 41013.79 while the gross income and net income were estimated to be Rs. 68376.91 and Rs. 27363.12 per loom respectively. However, the net present value was Rs. 220340.61 per loom and internal rate of return (IRR) was 71.39 per cent with a discounted benefit cost ratio of 1.62 which reflected the economic feasibility of investing in weaving. 8 Out of the sixteen problems reported from the study, high prices of raw materials (GS: 77.60), inadequate

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working capital for timely purchase of yarn (GS: 70.40) and lack of adequate skilled labour (GS: 56.96) were the some of major production problems encountered by the weavers. Fluctuation in prices of finished products (GS: 69.76), hike in transportation cost (GS: 59.84) and decrease in demand for handloom products due to availability of power loom product at lower price (GS: 53.50) were some of the marketing problems along with certain health related problems such as leg pain (GS: 65.50), shoulder, neck and lower back pain (GS: 64.00) and headache (GS: 53.50) were also reported from the study area.

## **Morpho-Molecular Characterization of Rajmah (*Phaseolus vulgaris* L.) Genotypes**

*Dikshita Hazarika*

Among the legume crops of the world Rajmah or Common bean holds an important position and is mostly consumed in the form of young pods or dry seeds. Asia alone contributes 50% of world production and is mostly grown in India, China and Myanmar etc. In India, it is grown in Jammu and Kashmir, Himachal Pradesh, Uttar Pradesh and some parts of Maharashtra, Andhra Pradesh, Western and Eastern Ghats and North East India. It is also known as “Grain of Hope” and is a nutritionally very rich. However the crop is not common among the farmers of Assam because of lack of availability of high yielding and environmentally stable varieties. Thus, it is vitally important to estimate the variability among Rajmah genotypes to develop improved varieties suitable for the climatic conditions of Assam. The present study was carried out using ten genotypes out of which one is a check variety. Nine quantitative and eleven qualitative traits were observed to estimate the genetic variability for different morphological traits. Further molecular diversity analysis was done using 30 SSR markers to study the relatedness among the Rajmah genotypes. The analysis of variance revealed significant variation among the genotypes and on the basis of their mean performance the genotypes Accession No 31, Local Collection 1, SRC-1, and Accession No 16 were found to be the best performing genotypes for different yield components. High GCV and PCV were observed for plant height, number of pods per plant, pod length and hundred seed weight. High heritability along with high genetic advance was seen in the traits plant height, number of pods per plant, pod length, hundred seed weight and seed yield per plant. Significant variation was also seen between the genotypes on the basis of qualitative traits as well. Four clusters were observed based on Mahanobis D2 statistics. Cluster I consisted of the maximum number of genotypes whereas Cluster II, III and IV were solitary clusters. The highest inter-cluster distance was found between Cluster III and Cluster IV. Thirty microsatellite markers which included 7 newly designed ones were used to study the molecular genetic diversity. Out of the 30 primer pairs, 25 showed amplification and among the amplified ones 11 were

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found to be polymorphic. The PIC ranged from 0.18 to 0.78 with a mean value of 0.54. Jaccard's similarity coefficient values were estimated and it ranged from 0.36 to 0.82. The genotypes Accession No 19 and Local Collection 1 showed lowest similarity values.

# **Genetic variability analysis in F<sub>2</sub> populations of indian mustard (*Brassica juncea*) (L.) Czern. & Coss.)**

*Gracia Maisnam*

*Brassica juncea* (L.) Czern & Coss (AABB) is India's second most important edible oilseed crop after soybean. *Brassica juncea* is a natural allotetraploid of two diploid species, *Brassica rapa* (AA) and *Brassica nigra* (BB). The genetic potential for high economic output exists in the mustard species. Compared to toria (*Brassica rapa*), the mustard plants are significantly taller. It has a substantially larger biological production than toria and sturdy stems, unlike toria. A key requirement for the crop development programme in Indian mustard is the presence of genetic diversity in the selection of superior genotypes. It is necessary to comprehend the relationships between character for effective indirect selection of traits. Thirty-seven genotypes were cultivated in the Rabi 2021-2022, in a Randomized Block Design with two replications. The genotypes included ten parental lines {four low erucic acid varieties, one double zero variety (*Brassica napus*), three *Alternaria blight* tolerant lines, two high yielding lines (under Assam conditions)}, along with twenty-six F<sub>2</sub> populations and one check variety. To examine the genetic diversity among the germplasms, fourteen quantitative characters were analyzed. The results of the analysis of variance showed that there was a considerable genetic variation for all the traits among the genotypes under investigation. High GCV & PCV were found for biological yield per plant, seed yield per plant, number of infected leaves per plant and number of lesions on the infected leaf, which indicated the potential variability for these attributes. High heritability was observed for the characters, days to 50% flowering, days to maturity, plant height, number of secondary branches and number of lesions on the infected leaf. The correlation analysis has shown that there was a considerably positive correlation between seed yield per plant with days to maturity, number of secondary branches, biological yield per plant, harvest index and number of lesions on leaf. Path coefficient analysis revealed that most of the characters had a high positive direct effect with seed yield per plant, with the exception of days to 50% flowering, number of primary branches, number of seeds per siliqua, 1000 seed weight, number of lesions on the infected leaf and lesion size, which

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had a strong negative direct effect. Hayman, 1958 graphical analysis demonstrated partial dominance for days to 50% flowering, days to maturity, number of secondary branches, number of seeds per siliqua, biological yield per plant, harvest index, seed yield per plant, number of lesions on the infected leaf and number of infected plants per plot. While plant height, number of primary branches, 1000 seed weight and number of infected leaves per plant expressed over dominance. Hayman's study was found to be invalid due to significant  $t^2$  values for days to maturity and number of infected plants per plot therefore, only numerical analysis was performed for these traits. A total of 60 SSRs (27 were *Alternaria blight* gene linked and 33 were random) markers was used for assessing the molecular diversity of the parental genotypes. Among these 13 *Alternaria* gene linked and 24 random markers showed polymorphism. So, total of thirty-seven SSRs exhibited polymorphism and the rest were found to be monomorphic in nature. The PIC value ranges from 0.170 (BN25A) and 0.780 (Ni2B03). Jaccard's coefficient similarity value ranges from 0.547 to 0.881, with a mean of 0.326. Clustering was done based on Jaccard coefficient of similarity and the genotypes Pusa Mahek and GSC-6 were found to be least similar, whereas, DLSC-1 and PM-24 exhibited the highest similarity. The marker data generated can be utilized in further breeding programmes. Among the germplasms screened for disease reaction six were found to be moderately resistant. Additionally, it was observed that the segregating populations showed a high disease incidence with good yield, indicating tolerance to the disease. As a result, the promising genotypes indicated above can thus be taken into consideration for future analysis.

## **Heterosis and Combining Ability Analysis for Yield and Yield Attributing Traits in Sesame (*Sesamum indicum* L.)**

*Jugal Chandra Talukdar*

Sesame is considered to be the oldest oilseed crop known to mankind. It is regarded as the “Queen of Oilseeds” because of its high oil content, excellent cooking quality and presence of powerful antioxidants. The factors responsible for the low productivity of sesame in India are its narrow genetic base, less attention to genetic improvement and poor management practices. One of the possible methods for enhancing its productivity is the exploitation of heterosis through the development of hybrid varieties or selection in the segregating generations for recovery of promising segregants. The study entitled “Heterosis and Combining Ability Analysis for Yield and Yield Attributing Traits in Sesame (*Sesamum indicum* L.)” was undertaken by utilizing seven parental genotypes which were crossed in a half diallel mating design during Kharif, 2019. The resultant 21 F1 hybrids along with their parents and a standard variety (ST-1683) were evaluated in a Randomized Block Design (RBD) with three (3) replications at the Plant Breeding Block of Biswanath College of Agriculture, Biswanath Chariali during Kharif, 2020. The objectives of the study were to estimate the magnitude of heterosis for seed yield and its components, to estimate the combining ability effects and variances of the parents and crosses and to identify the promising sesame genotypes and cross combinations for future breeding programmes. The observations were recorded for seed yield per plant and 14 other morpho-physiological yield attributing traits. Analysis of variance revealed significant differences among the genotypes for all the 15 characters studied. Significant heterotic expression over better parent and standard variety was observed in 17 out of 21 crosses for seed yield per plant. The cross ALS-5 x Bahuabheti recorded maximum heterobeltiosis of about 59 %, while two other crosses, viz., ALS-1 x ALS-11 and ALS-1 x ALS-5 exhibited maximum heterosis of about 48 % over the standard variety for seed yield per plant. Several heterotic crosses in desirable direction with regard to earliness and other yield attributing morpho-physiological traits were also identified. GCA and SCA variances revealed the importance of both additive and non-additive gene action for the expression

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of these traits. The variance due to SCA was found to be higher than the variance due to GCA indicating preponderance of non-additive gene action for the expression of all the characters. Among the seven parental genotypes, ALS-1 and ALS-11 were considered as good general combiners for seed yield, 1000-seed weight and harvest index. Based on the high positive heterotic values and significant SCA effects for seed yield, the hybrids ALS-1 x ALS-5 and ALS-1 x ALS-11 were considered as superior and promising. Thus, these hybrids could be used in future breeding programmes for better utilization of heterosis. The correlation studies revealed that the characters, viz., plant height, number of capsules per plant, length of capsule, number of seeds per capsule, 1000-seed weight, leaf area index, biological yield per plant and harvest index, were positively associated with seed yield.

## **Performance analysis of seed and seedling characteristics of rice and pigeon pea using nano particle mediated seed treatments**

*Jyotimoni Gogoi*

The present investigation was undertaken to assess the performance of seed and seedling characteristics of rice and pigeon pea using nano particle mediated seed treatments. Direct seeded rice variety PR126 was treated with oxides of silicon, zinc and titanium nano particles @100, 250, 500 and 750 ppm along with two controls i.e., dry seed and hydro primed seeds (recommended package of practice). To study the effects of nano treatments in pigeon pea, varieties Pusa991 and Pusa992 were treated with silicon dioxide and zinc oxide nano particle @50, 100 and 500 ppm along with the control. Various seed quality parameters were evaluated viz.; germination, seed vigor and seed health using standard protocols. In rice, seed treatment with ZnO @250 ppm was observed best for all germination and vigour characters i.e., radicle emergence (89.00%), germination percentage (96.00%), field emergence (90.33%), seedling shoot length (9.10cm), root length (9.06cm) and seed vigour index I (1743.91). In pigeonpea the seed treatment with SiO<sub>2</sub> @50 ppm in the variety Pusa991 was found to be best among all other treatments for seed germination and seedling vigour characters i.e., radicle emergence (91.00%), germination percentage (84.00%), field emergence (83.33%), seedling shoot length (10.32cm) and seed vigour index I (1515.27). Correlation coefficient analysis revealed that there is a strong correlation between radicle emergence, germination 1st count, germination%, field emergence and seed vigour index I in Rice. In pigeonpea there is significant correlation among radicle emergence, germination 1st count, germination %, field emergence, seed vigour index I. Positive and significant correlation was also observed between seed reserve utilization rate (SRUR) and seed health. Occurrence of seed borne pathogens were found to be low in treated seeds compared to control seeds indicating probable role of seed treatments in lowering seed borne pathogens in most cases. The ELISA revealed that, the concentration of aflatoxin was low in the treated seeds over control in both the crops. Therefore, these treatments may be useful in lowering aflatoxin in seed, thus can be applied for improvement of seed quality parameters including seed health status.

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**Department: Plant Breeding and Genetics, (SST)**

**Major Adviser: Dr. Sharmila Dutta Deka**

## **Studies on genetic variation and character association in brinjal (*Solanum melongena* L.)**

*Kishore Medhi*

The present investigation entitled as “Studies on genetic variation and character association in brinjal (*Solanum melongena* L.)” was executed to study the variability, heritability, genetic advance, correlation coefficient, direct and indirect effects of interrelated characters and genetic diversity present among the 16 brinjal genotypes at Horticultural Experimental Farm, Assam Agricultural University, in the year 2020-2021.

Analysis of variance revealed that substantial genetic variation present among the genotypes for each observed characters. High genotypic and phenotypic coefficient of variation were recorded for number of fruits per plant, fruit length, fruit girth, fruit weight and fruit yield, which indicates that the existence of broad genetic base. Hence,, it would be amenable for further selection. High heritability was estimated for fruit length, fruit girth, number of fruits per plant, number of primary branches per plant, first harvest and fruit yield. High heritability accompanied with high genetic advance was observed for fruit length, fruit girth, number of fruits per plant, fruit weight, number of primary branches per plant, first harvest and fruit yield, indicating these traits are controlled by additive genes. Hence, these characters can be improved through simple selection.

Correlation coefficient revealed that fruit yield per plant had positive correlation with fruit weight, plant height and fruit girth at both phenotypic and genotypic level. Fruit yield per plant was also found to be positively correlated with fruit length, root length, root dry weight percentage and first flowering node number at genotypic level. Hence, genetic improvement of fruit yield can be obtained by direct selection of these independent component traits. Genotypic correlation also revealed that positive association among the desirable traits such as, fruit weight with plant height, Fruit weight with fruit girth, days to first flowering with days to 50% flowering, number of fruits per plant with number of primary branches per plant. Hence, selection for such positively associated characters might help the improvement of fruit yield. Path coefficient analysis revealed that characters namely, fruit length, fruit girth, number of

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fruits per plant, number of primary branches per plant showed maximum positive direct effects on fruit yield. So, direct selection of these characters may be effective for the further yield improvement programmes.

Based on the Mahalanobis  $D^2$  statistics, 16 brinjal genotypes were grouped into 4 clusters. Cluster I consisted of maximum genotypes (7) followed by cluster II (6), cluster III (2) and cluster IV (1). Maximum intra cluster distance was obtained in cluster III (363.26) followed by cluster II (219.63) and cluster I (145.75). High degree of divergence among the genotypes within a cluster would produce a wide range of segregating material. Maximum inter cluster distance was obtained between the cluster III and cluster IV (6340.56) followed by cluster II and cluster III (4026.45), cluster I and cluster IV (2660.97), cluster I and III (1566.42) and cluster I and II (1141.38). This clustering will help the breeders to choose the diverse parents for hybridization programme, which leads to recombination of non-identical genes.



## **Genetic variability studies on rice genotypes of Assam for ratooning ability and perenniality**

*Neha Chakrawarti*

The objectives of the research were to assess the genetic variability and diversity among 50 rice genotypes with respect to ratooning ability and perenniality. Inter-relationship of some main crop traits to that of ratooning ability and perenniality was also studied. Path Coefficient analysis was carried out to dissect the direct and indirect effects of main crop traits to ratooning ability and ratoon yield of the genotypes. Crossability studies of *O.sativa* genotypes with *O.rufipogon* and *O.longistaminata* was carried out. Out of 50 genotypes, only 30 genotypes showed different degree of ratoon production and ratoon yield. All the genotypes showing better ratooning ability mainly belonged to photoinensitive group and only few were slightly photosensitive. True perenniality as expressed by formation of rhizome (eg in *O.longistaminata*) was not observed in any of the genotypes. However, stolen formation as in *O.rufipogon* was observed only in one genotype Terabali In ANOVA, all the observed traits in main crop exhibited significant genotypic coefficient of variation while in ratoon crop all the traits except number of dwarf tiller, number of lodging tiller and ratoon yield per tiller showed significant variation among ratooning genotypes. Genotypes namely Binadhan-11, Sayjihari and IR-64 were found to be best performing for all the desirable ratoon crop traits. GCV and PCV were moderate to high for all the ratoon crop traits except days to ratoon maturity. High heritability coupled with high genetic advance was estimated for all the ratoon crop traits except for days to ratoon maturity indicating the involvement of additive gene action in the expression of the traits. Ratooning ability was found to be significant and positively associated with four main crop traits namely, tiller wall thickness (0.74), greenness of leaves at maturity (0.64), tiller diameter (0.37) and tiller weight (0.34). It was negatively correlated with plant height and harvest index of the main crop. In ratoon crop all observed traits except ratoon plant height, number of lodging tillers and number of dwarf tiller exhibited significant positive correlation with ratoon yield per plant. Genotypic path coefficient analysis indicated that tiller wall thickness (0.59) and tiller weight (0.47) of the main crop had highest positive direct effect on ratooning ability among all the main crop traits suggesting that these traits were essential for better ratooning ability while plant height

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and harvest index had negative direct effects. In ratoon crop, number of productive ratoon tiller (4.36) had highest positive direct effect on ratoon yield. Diversity analysis revealed that all the ratooning genotypes grouped into 10 clusters. Cluster III (Binadhan-11 and Sayjihari) followed by cluster VI (IR-64, DRR-44) were the best performing cluster for all the desirable traits in ratoon crop. The analysis also revealed the relative genetic distances among the genotypes. Crossability of *O.longistaminata* with *O.sativa* ranged from 11.1% to 22.2% while crosses between *O.rufipogon* and *O.sativa* ranged from 13.3% to 30%. Hybrids (F1) from *O.sativa/O.longistaminata* crosses mostly exhibited intermediate traits. The polled pollen viability of the hybrids were found to be very low (30% to 40.2%) and as such natural seed set is almost nil. The hybrids exhibited various distinguishing characters which can be used as morphological marker in further breeding programme.

## **Evaluation of grass pea (*Lathyrus sativus* L.) landraces for $\beta$ -ODAP content, fodder and grain yield**

*Niharika Dutta*

Grass pea (*Lathyrus sativus* L.) is an important cool season legume crop cultivated for its nutritious grains and green fodder. It is commonly known as 'khesari' and is widely cultivated in India, Bangladesh, Ethiopia, etc., due to its hardy nature and high protein content. However, the presence of neurotoxin  $\beta$ -ODAP and low productivity are the main constraints for grass pea cultivation. The development of grass pea varieties with low  $\beta$ -ODAP content and high yield is the major objective of a grass pea breeding programme. Besides that, the information on genetic variability among local grass pea landraces is scanty. Therefore, in the present investigation, fourteen grass pea landraces of Assam along with two released varieties were assessed for genetic variability, character association and genetic diversity based on twenty-one quantitative traits and three qualitative traits. Significant variation was observed for  $\beta$ -ODAP content, fodder and grain yield, and related traits except for pod length and pod width. Based on the mean performances, JCL-21-N-1, JCL-21-N-5 and JCL-10-4 were found promising for green fodder yield and its attributes whereas JCL-21-N-3, JCL-21-N-1 and JCL-21-N-4 exhibited high grain yield. JCL-21-N-1, JCL-21-N-4 and JCL-10-4 were the genotypes with high yielding ability along with low  $\beta$ -ODAP content and high crude protein content. The only genotype with the combination of low  $\beta$ -ODAP content, high fodder and grain yield was JCL-21-N-1. High GCV and PCV were observed for  $\beta$ -ODAP content in leaf and seed and dry matter yield per plant. High heritability coupled with high genetic advance was recorded for  $\beta$ -ODAP content in leaf and seed, crude protein content in leaf, green forage yield per plant, dry matter yield per plant and leaf width. The sixteen genotypes were grouped into four different clusters based on Mahalanobis D2 analysis. The highest inter-cluster distance was observed between cluster III and cluster IV. Correlation and path analysis revealed the importance of number of leaves per plant, primary branches per plant, secondary branches per plant and dry matter yield per plant for improvement of green forage yield. On the other hand, the number of pods per plant, number of effective pods per plant and seeds per pod were observed to be the most important traits for improving grain yield.

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## **Characterization of soybean genotypes based on morphological and molecular markers**

*Niharika Saharia*

Soybean has attained important status in agriculture and oil economy of the country. It is a distinctive multi-purpose crop with ever increasing popularity due to various health benefits. It is imperative to estimate the nature and extent of variability among soybean genotypes to develop improved varieties suitable for varied agroecological situations. Moreover, there is limitation of molecular marker based diversity analysis in a precise way among the genotypes used for varietal breeding programme. The present investigation was carried out with 38 soybean genotypes during Kharif, 2020. In the field experiment, the data on qualitative traits were taken on plot basis, while data on quantitative traits on five plant basis were recorded. For molecular analysis, 24 SSR primers were used to assess fingerprint pattern for estimation of genetic relatedness. A wide range of variation was noticed for all characters. Highest GCV and PCV were recorded for the plant height, the branches per plant, the pods per plant and seed yield along with high heritability and genetic advance as per cent of mean. Per se performance revealed that different genotypes possessed different desirable yield attributes. However, genotype NRC-128, JS 22-11, ASb-9, DS 3105 and NRC-109 were the best genotypes based on per se performances for different yield components. Seed yield per plant showed positive association with the plant height, the branches per plant and the pods per plant. Path coefficient analysis identified that the pods per plants could be used as a direct or indirect selection criterion in identification for higher-yielding genotypes, along with emphasis on selecting for more branches per plants in tall plant. Among the qualitative characters, hilum colour, pubescent density and pubescent type had the maximum distinguishing potential (4 classes) indicating their importance in describing the genotypes. Euclidean distance based on qualitative characters indicated the genotype DLSb-2 and JS 22-14 to be most divergent, while that based on quantitative characters revealed the maximum divergence between the genotype NRC 128 and TS20-5. The Mahalanobis D<sub>2</sub> value was observed to be highest between NRC-128 and NRC-109, which were placed in different clusters with maximum inter-cluster distance between them. Out of 24 soybean specific SSR primers, 19 were found to be polymorphic. The number of SSR allele per locus ranged from one

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to three with an average of 1.4 alleles per locus. The PIC value ranged from 0.10 (Satt416) to 0.79 (Sat\_172) with an average of 0.37. Jaccard's coefficient of similarity (SSR marker based) ranged from 0.52 to 0.97 with an average value of 0.72. No concordance was found between the distance matrices of morphological and molecular markers.

## **Studies on Genetic Divergence in Oats (*Avena sativa* L.)**

*Parameshwaran M*

Oats is one of the most important and economically valuable crops throughout the world as food, feed, and fodder. As a *Rabi* crop, it yields succulent green fodder as well as grains rich in antioxidants, good dietary fibers, and unsaturated fatty acids. The present investigation was carried out using 31 genotypes of oats during *Rabi* 2021-22. Twenty-four different traits were recorded from the field to measure the genetic variability and diversity among the accessions. Dendrogram based on SSR polymorphism was also constructed using the Unweighted Neighbour Joining (UNJ) method. Among the 12 fodder component traits, high GCV and PCV along with high  $h^2$  b coupled with high GAM% was noticed for no. of tillers per plant, dry matter yield, and green fodder yield. The plant height, number of leaves per plant, leaf length, leaf width, number of tillers per plant, dry matter yield, and crop growth rate showed a significant positive correlation with green fodder yield. Path analysis suggested that the tall plant with numerous tillers along with a higher growth rate could be the indirect selection criteria for green fodder yield. The genotypes OL-1861, JHO-851, and NDO-711 were the most promising for the green fodder yield improvement.  $D^2$  distances generated 7 various clusters and the genotypes observed as the best for fodder yield were placed in cluster I. Among 12 grain component traits, no. of effective tillers per plant, spikelet number per panicle, 1000 seed weight, and grain yield per plant exhibited high GCV and PCV along with high  $h^2$  b coupled with high GAM%. There was a significant positive correlation of 1000 seed weight, flag leaf length, panicle length, no. of effective tillers per plant, and spikelet number per panicle with grain yield per plant. Early flowering genotypes with an increased number of effective tillers could be the selection index for grain yield as suggested by path analysis.  $D^2$  statistics for grain component traits revealed 7 different clusters among which Cluster IV holds JHO-2000-4 and NDO-711 which were the most promising genotypes for grain yield. A total of 30 SSRs including 10 newly mined were used for assessing the molecular diversity. Out of 30, 15 SSRs got amplified and 7 showed polymorphism. The average number of alleles per locus was reported to be 2.07. The PIC ranged between 0.96 (AM87) and 0.15

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(AAM06). Pairwise dissimilarity values ranged from 0 and 0.982 with the mean value of 0.535 was used to construct the dendrogram. Such wide variation of dissimilarity values suggests the presence of considerable diversity among the genotypes in the study. The highest dissimilarity value was observed between the genotypes OS-6 and OL-10 (0.982). Therefore, the above highlighted promising genotypes can be considered for further use in breeding programmes and recommended for cultivation in the Northeastern states after critical evaluation

## **Combining Ability for Yield and Yield Attributes in Indian Mustard [*Brassica juncea* (L.) Czern & Coss]**

*Prastuti Bhattacharyya*

Indian mustard [*Brassica juncea* (L.) Czern. & Coss.] holds a notable position among the oilseed crops grown in the world and has emerged to be the second most important oilseed crop in India. However, the crop is not popular among the farmers of Assam as it does not fit well into the cropping system due to the longer duration required for its maturity. Thus, developing a mustard variety with short height, shorter duration without compromising the yield can change it into a valuable crop in Assam. The disease *Alternaria* blight seems to be a major issue in the area affecting the yield up to a great extent, thereby attracting attention for its consideration during the study of the yield parameters. The research was guided with a target to the analysis of variability among the parents and F1s, character interrelationship, and combining ability in the diallel cross. Ten genotypes were grown in the Rabi 2019-20 containing three *Alternaria* blight tolerant lines, two high yielding lines (under Assam conditions), four single zero varieties, and one genotype that was a double zero variety belonging to the *Brassica napus* species. Diallel crosses were made between five selected parents to produce F1 progeny including reciprocals to study the nature of gene action involved in the expression of quantitative traits which were subsequently grown in Rabi 2020- 21 along with other genotypes. Some of the other crosses that were presumed to be consequential were also developed and evaluated to develop breeding materials having quality oil content with lower amounts of erucic acid with the least impairment in yield. The analysis of variance (pooled) revealed significant variation among the parents for all the characters under study indicating the presence of exploitable variation among the genotypes included in the experiment. Moderate genotypic coefficient of variation and phenotypic coefficient of variance for most of the characters and high broad-sense heritability was observed for all the traits under study. High genetic advance coupled with high heritability was observed for the characters, foot length, thousand seed weight, seed yield per plant, plant height, number of primary branches, number of secondary branches and biological yield per plant which denotes the probable preponderance of

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additive gene effects and selection may be effective. Since yield is polygenecally controlled and highly influenced by the environment, selection based on yield alone is not effective. From correlation analysis studies in both the years, it can be concluded that days to maturity and plant height were the major yield attributing traits which showed strong negative genotypic correlation with the character, yield per plant. The path analysis of both the years revealed that the characters, days to 50% flowering, number of secondary branches per plant, number of pods per main shoot and number of seeds per siliqua had direct positive effects on seed yield per plant. From the analysis of variance for combining ability, significant variation among the parents, among the total crosses, among F1s and among the reciprocals was inferred, which indicates the presence of genetic differences among the parental genotypes and their prepotency. Moreover, the significance of the difference between Parent vs F1s was observed for all the characters under study, which suggests the presence of heterosis, while in the case of F1 vs Reciprocal, significant variation was observed for most of the characters. This denotes the preponderance of reciprocal effect. From the evaluation of GCA in parents, the genotypes EC339000 and Pusa Mahek were found to be good combiners with high GCA for early maturity, early days to 50% flowering and low foot length, while, TM-2 for seed yield per plant. The crosses TM-2 x PM21, followed by PHR2 x PM21 depicted positive significant SCA effects for seed yield per plant and also exhibited high positive significant heterosis over better parent for the character. The banding patterns of 10 SSR gene-linked markers were studied, out of which 9 primers showed polymorphism. The PIC value was calculated which ranged from 0.190 to 0.927. Clustering was done based on Jaccard coefficient of similarity and the genotypes DLSC-1 and Pusa Mahek were found to be most similar, whereas, TM-2 and PM22 exhibited the least similarity. The marker data generated can be utilized in further breeding programmes

# **Morphological and molecular characterization of M5 mutant lines of indian mustard (*Brassica juncea* (L) Czern. & Coss.) Cultivar NRCHB-101**

*Richa Bora*

Indian mustard [*Brassica juncea* (L.) Czern. & Coss.] is an important oilseed crop grown in India under diverse agro-ecological conditions in the temperate and subtropical regions during Rabi season. It fits well in the rainfed cropping system with low production cost and high potential to increase edible oil. Farmers in Assam grow rapeseed toria due to its short duration but ends up with low yield. Development of short duration high yielding Indian mustard varieties is required to increase the average yield of rapeseed-mustard in Assam. To this end some Indian mustard genotypes were developed by mutagenesis through gamma irradiation of variety NRCHB-101. In the present study, 115 M5 lines from this mutation breeding programme were evaluated during Rabi 2021-22 to assess to genetic variation for agro-morphological traits related to yield and molecular markers. The analysis of the data revealed ample induced genetic variation for all the variables. High genotypic coefficient of variation was observed for stem thickness, siliqua density, oil yield per hectare and seed yield per hectare. High heritability was observed for days to maturity, stem thickness, seed yield per hectare, oil yield per hectare, oil content, thousand seed weight and plant height. High estimates of genetic advance as percent of mean was observed for seed yield per plant, number of secondary branches, number of primary branches and thousand seed weight. Molecular analysis was carried out by simple sequence repeat assay in 40 of the 116 genotypes including the parent. Out of the 36 random SSR primers tried, 18 primers showed polymorphism. The PIC value ranged from 0.021 to 0.638. Clustering was done on the basis of Jaccard's coefficient of similarity. The 40 genotypes were grouped into two diverse clusters, each of which was divided into two sub-clusters indicating their diversity. The SSR markers could be used to tag important traits. As many as 20 M5 lines were identified as short duration (99-105 days) and high yielding with seed yield advantage of 27.3 - 130.2 percent over the parent (1008.5 Kg/ha). Further evaluation and selection of these lines could result in the required short duration high yielding varieties of Indian mustard for Assam and Northeast India.

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## **Studies on genetic variation for pesticide induced chromosomal aberrations in onion ( L.)**

*Ritika Chakrabarty*

Pesticides have been in use in agriculture since decades for crop protection and production. Farmers use chemical insecticides, fungicides and herbicides to control insect pests, diseases and weeds. Extensive use of chemical pesticides is becoming hazardous to the environment and human and animal health. Biopesticides have been used as a safer alternative. However, it is also important to know the merits and demerits of using biopesticides in the long run. In this investigation the effects of a chemical systemic insecticide 'Actara 25WG' and a bioinsecticide 'Bio Sona' were assessed for seed germination and seedling growth, and on their effect on root mitosis in five varieties of onion. Experiments were conducted in pots under polyhouse for seedling growth and in the laboratory for germination and cytogenetic study. Three concentrations of Actara 25WG viz., @ 25 g/kg seed, 50 g/kg seed (recommended dose) and 75 g/kg seed were used for seed treatment and @ 200g/ha; 400g/ha (recommended dose) and 600 g/ha for soil application. Bio Sona was applied as soil and seed treatment @ 2%; 5% (recommended dose) and 8%. Negative effects of the two pesticides were observed on seed germination except for Bio Sona at 2% concentration in the variety Bhima Shakti. Actara 25WG and Bio Sona were found to have stimulatory as well as inhibitory effects on seedling height, seedling leaf length, seedling leaf diameter, number of leaves per seedling, root length of seedling, seedling fresh and dry weight depending on the pesticide, concentration and genotype of onion. Each variety showed different level of sensitivity towards the pesticides. Cytogenetic analysis revealed that mitotic index was either promoted or depressed depending on the concentrations of the pesticides and the variety. These pesticides also induced genotoxic effects on root tip cells by showing chromosomal aberrations like binucleate cells, clumps, stickiness, disturbed stage, laggards, bridges and fragments. Bio Sona showed more aberrations than Actara 25WG. There was differential response of the varieties to the pesticide treatment. High heritability, genotypic variation and genetic advance were observed for seedling dry weight and mitotic index.

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## **Genetic Variability and Diversity Analysis in Potato (*Solanum tuberosum* L.)**

*Shibani Ritusmita Borah*

Potato (*Solanum tuberosum* L.), one of the most significant non-cereal food crops, comes in fourth place globally next to rice, wheat and maize (Hayder et al., 2007). Being a short-duration crop, it generates more calories and protein per unit of land area with less time and water compared to most of the major food crops. Potato exhibits considerable variation for a number of traits which provide greater scope for improving this crop through selection. The yield and production of potato in Assam as well as in NE region is very poor. Some of the reasons for such a low yield of potato in Assam are poor crop management, high disease and pest pressure, use of low quality seed and lack of disease free seed tubers. There is an urgent need to identify suitable genotypes for Assam with high yield potential, resistant to major pests and diseases as well as steady performance across a range of environmental factors. The present investigation was carried out with thirty three diverse genotypes of potato in the ICR farm of Assam Agricultural University, Jorhat in Randomized Block Design with three replications during Rabi season of 2021- 2022. Analysis of variance for 17 characters showed that there existed highly significant differences among the genotypes, indicating an ample amount of genetic variability among the genotypes. High genotypic and phenotypic coefficients of variation were observed for characters like leaf area index, stem diameter (cm), number of tubers/plant, average tuber weight(g), tuber yield/plant(g), marketable yield/ha(q), non-marketable yield/ha (q), tuber volume (cm<sup>3</sup>), number of eyes/tuber, shoot dry weight (g/plant), tuber dry matter content (%), and total yield/ha (q). High heritability coupled with high genetic advance as a percent of mean for the above mentioned characters was recorded, suggesting a preponderance of additive gene action, thus paving the way for direct selection. Total yield/ha was positively and significantly associated with tuber yield/plant and average tuber weight, suggesting that these traits are the prime traits that could be considered for selection to increase tuber yield. The high positive effect on tuber yield through the number of tubers/ plant and average tuber weight suggests good scope for improvement of tuber yield by selecting plant types bearing a greater number of tubers with a higher tuber weight. Based on Tocher's method, 33 genotypes were grouped into 3 clusters. SM/20-3

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was found to be superior to Kufri Surya (improved check) in terms of tuber yield. Twenty pairs of SSR primers were used to study the genetic diversity among the genotypes, out of which five were found to be polymorphic. The PIC value of loci ranged from 0.6196 (STM 5136) to 0.841 (STM 1024), with an average PIC value of 0.187 per locus. Overall, the SSR analysis delineated two different clusters of potato genotypes, which might be useful for breeding better varieties. Evaluation of genetic divergence is important for an efficient choice of parents for breeding and to ensure genetic variation for successful potato improvement.

## **Studies of variability and divergence for seed and seedling traits of rapeseed and mustard**

*Sikha Barman*

The oilseed Brassicas collectively known as rapeseed-mustard are amongst the oldest cultivated plants in human civilization. Indian mustard [*Brassica juncea* (L.) Czern & Coss.] and Rapeseed (*Brassica rapa* L.) are among the most important oilseed crops of India. In the present study a set of five yellow sarson, five toria and ten Indian mustard genotypes were evaluated during year Rabi 2019-20 and 2020-21 to analyse seed quality traits in rapeseed and mustard genotypes and to estimate the genetic variability, diversity and character association among seed and yield related traits. Observations were recorded for seven qualitative characters and nineteen seed quality and yield related quantitative characters. The qualitative characters were assessed based on the DUS (Distinctness, Uniformity and Stability) guidelines, PPV (Protection of Plant Varieties) & FRA (Farmers' Rights Authority), Government of India. The pooled analysis of variance of the experiment revealed significant variation due to genotypes, environments and genotype-environment for majority of the characters. Highest GCV and PCV was observed for the trait germination index, followed by seed yield per plant and main shoot length. High heritability coupled with high genetic advance was observed for the traits: days to 50% flowering, plant height, number of primary branches per plant, main shoot length and germination index. According to the seed quality parameters the superior genotypes identified based on mean performance were: BNYS-1, BNYS-2 and B9 among the yellow sarson genotypes, Jeuti, TS-46, TS-38 and TS-67 among the toria genotypes and NRCHB-101, TM-2 and 34 M3 TM-2 among the Indian mustard genotypes. According to the seed yield and related parameters the superior genotypes identified based on mean performance were: BNYS-1, BNYS-2 and B9 among the yellow sarson genotypes, TS-46, Jeuti and M-27 among the toria genotypes and NRCHB-101, TM-2, 44 M3 TM-2 and 34 M3 TM-2 among the Indian mustard genotypes. Significant positive correlation with seed yield per plant was exhibited by the characters days to maturity, main shoot length and number of siliquae on main shoot. Main shoot length exhibited highest positive direct effect towards seed yield per plant followed by siliquae density, seeds per siliquae, days to maturity and primary branch number per plant. Number of siliquae on main shoot exhibited maximum negative direct

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effect, followed by plant height, oil content and thousand seed weight. Genetic diversity was carried out by cluster analysis using Euclidean distances followed by the method UPGMA (unweighted pair group method with arithmetic mean). Cluster analysis based on seed quality and yield related traits reported formation of five distinct clusters among the 20 rapeseed and Indian mustard genotypes. The material used in the experiment was found to be diverse and promising for development of improved mustard-rapeseed genotypes in the future breeding programmes.

## **Assessment of seed quality and incidence of aflatoxin in maize during storage**

*Sulakshana Baruah*

The present investigation was undertaken to assess the seed quality attributes and incidence of aflatoxin in maize seeds in different treatment combinations at two different storage periods. Equal amounts of seeds of maize composite variety Vivek Sankul Makka-35 were stored in nine different bag-seed treatment combinations consisting of three bags namely, 150micron polyethylene bag (PEB), high density polyethylene interwoven bag (HDPE) and polylined jute bag (PLJB) and three levels of seed treatments viz., turmeric powder @ 20g/ kg of seeds (TP), carboxin 75% WP @ 2.5g/ kg of seeds (carboxin) and control. The seeds were stored up to six months. At three months of storage, PEB gave the most favourable mean performance for germination index, shoot length, seedling length, field emergence, and percent seed infection and it was at par with HDPE for these characters. PEB gave the best mean performance for moisture content, shoot length, seedling dry weight and field emergence at six months of storage. Seeds treated with carboxin 75% WP showed the most favourable mean performances for moisture content, germination index, root length, seedling length, seed vigour index-I, seed vigour index-II, field emergence and percent seed infection at both three and six months of storage. The bag-seed treatment combination of 150 micron polyethylene bag-carboxin 75% WP (PEB-carboxin) gave the best performance than other bag-seed treatment combinations in both three and six months of storage in respect of moisture content, shoot length, seedling dry weight and percent seed infection. PEB-carboxin was found to be appreciably economic as compared to other bag-seed treatment combinations. It was observed from correlation of characters that, with increase in seed moisture content, there was decrease in shoot length, seedling length, seed vigour index-I and seed vigour index-II and increase in percent seed infection at six months of storage. Simple correlation coefficient between two periods of storage i.e., three months and six months, for each character was either significant or highly significant indicating consistent result or trend in increase or decrease of mean performance for a character from three months" to six months" period. Total aflatoxin concentration in maize seeds was observed to be of less than 3 ppb in six bag-seed treatment combinations while the amount was more in the three control bags at

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six months of storage. Treatments, thus, were found suitable for getting reduced incidence of total aflatoxin at the end of entire storage period.

## **Evaluation of Joha Rice (*Oryza sativa* L.) Mutants for Morpho-Agronomic Traits and their Photoperiodic Response**

*Tamma V.S.S. Manogna*

An investigation was carried out with 80 photoperiod insensitive mutant derived from 250 Gy gamma-irradiated seeds of Kon Joha during early Ahu, 2018. The M4 generation was evaluated with four check varieties, including the parent cultivar Kon Joha in augmented randomized block design in Sali, 2019. Out of the 80 mutants, ten mutants were selected with a more intense aroma and higher or comparable grain yield than the parent variety Kon Joha for evaluation under two NPK doses viz., @ 40: 20: 20 and 60: 20: 40 kg per hectare recommended for traditional and high yielding varieties, respectively in early Ahu, 2020 as M5 generation. The ten mutants and the four checks were laid out in RBD with three replications in each fertility environment. Compared to the parent cultivar Kon Joha, which is photoperiod sensitive, the mutants flowered in May-June when raised in early Ahu, 2020, confirming their photoperiod insensitivity. Analysis of variance in M4 generation revealed highly significant differences among the mutants for all the characters under study. Similarly, in the M5 generation, significant differences existed among the mutants for all the characters except plant height. The lowest values of days to first and 50% flowering, days to maturity, plant height and culm height were observed in the mutant KJM 250-22-15-16. However, it showed a low aroma score compared to the remaining mutants. The mutant KJM 250-22-17-48 exhibited the highest mean values for productive tillers hill-1, spikelet fertility, harvest index, grain yield hill-1 and desirable aroma, followed by KJM 250-22-17-75 and KJM 250-22-20-29, which needs advancement through further testing. The estimates of GCV, PCV, heritability and genetic advance were moderate or high for average panicle weight, filled grains panicle-1, chaff panicle-1, total grains panicle-1, spikelet fertility and grain yield hill-1, implicating the preponderance of additive gene action and the effectiveness of simple selection for these characters. The low estimates of GCV, PCV and genetic advance and the high heritability values for days to first and 50% flowering, days to maturity, culm length, and 1000-grain weights suggested the significance of non-additive gene action for these characters. Clustering by Unweighted Neighbour-

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Joining (UNJ) using usual Euclidean distance as dissimilarity measures based on 15 morpho-agronomic traits grouped the 80 mutants and four check varieties into three multi-genotypic clusters in M4 generation. In the M5 generation, ten mutants also fall into two multi-genotypic and one solitary cluster. Cluster1 included the tall mutants with the highest means for productive tillers hill-1 , average panicle weight, filled grains, spikelet fertility, grain size, biological yield hill-1 , harvest index and grain yield hill-1 . Correlation and path analysis in M4 generation revealed that panicle length, filled grains panicle-1 , spikelet fertility, 1000-grain weights, biological yield hill-1 and harvest index were the most important factors contributing to grain yield hill-1 . In contrast, in M5 generation, a direct selection based on culm length, total grains panicle1 , spikelet fertility, biological yield hill-1 and harvest index contributed significantly to grain yield. Any efforts to use these photoperiod insensitive mutants with strong aroma would help a long way in augmenting the area under aromatic rice and thereby uplifting the farming community's socio-economic status.

# **Studies on Genetic Variability, Diversity and Characterization of *Curcuma caesia* Roxb. Germplasm of North-East India**

*Tasnim Zumaina Mazumder*

*Curcuma caesia* Roxb. is an erect, perennial, medicinal rhizomatous herb belonging to Zingiberaceae family which is commonly known as black turmeric due to its bluish-black rhizome and is native to North-East and Central India. It is of immense therapeutical potential having pharmaceutical and industrial applications. *C. caesia* is now classified as an endangered species and therefore, conservation of this species is of utmost importance. Therefore, we characterised a set of 100 *C. caesia* germplasms with respect to 26 agro-morphological traits as per DUS guideline. Two of the 26 characters were found to be monomorphic, twelve each were found dimorphic and polymorphic in nature. In general, the germplasms of *C. caesia* were observed to be of tall height, long lamina length, medium lamina width, medium duration, medium primary rhizome length, and with high dry recovery percentage. They were mostly of compact pseudostem habit, semi-erect leaf disposition, close venation pattern, even leaf margin with compact rhizome habit. Genotypes had generally anthocyanin colouration on pseudostem, with strong blue colour rhizome, curved rhizome, coloured coma bract and rose bract tip colour. In case of yield contributing traits, highest GCV was observed for number of tertiary rhizomes followed by rhizome yield per plant and number of primary rhizomes. Therefore, selection would be effective for these traits. High heritability coupled with high genetic advance as per cent of mean was observed for most of the traits under study indicating selection would be effective for these traits. Rhizome yield exhibited positive and significant association with plant height, leaf lamina length, leaf lamina width, petiole length, primary rhizome length, number of primary rhizome, number of secondary rhizome and number of tertiary rhizome. Therefore, these traits might be used to establish the selection criterion for improving rhizome yield. Pathcoefficient analysis revealed that number of primary rhizomes exhibited the highest positive direct effect on rhizome yield followed by lamina width. Based on Mahalanobis' D<sup>2</sup>-statistics the genotypes were grouped into ten clusters out of which cluster III had maximum number of genotypes. Among all the characters studied,

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maturity duration exhibited maximum contribution towards divergence. The intracluster distance was maximum in cluster VIII. Cluster IV and X showed the maximum inter-cluster distance. The implication of genetic diversity and per se performances in planning future breeding programme were discussed.

## **Mutation Induction in Garden Pea (*Pisum sativum* L.)**

*Thalari Vasanth Rao*

The investigation on “Mutation induction in garden pea (*Pisum sativum* L.)” was carried out with two varieties of garden pea, Kashi Nandini and Kashi Uday, subjected to mutagenic treatments with chemical mutagen ethyl methane sulphonate (EMS). The experiments were carried out in two seasons, M1 generation during Rabi 2019-20 and the M2 generation during Rabi 2020-21 at the experimental farm of Assam Agricultural University, Jorhat. For growing the M1 generation, the pure, healthy and uniform seeds of the two varieties were treated with six different EMS concentrations (0.05, 0.10, 0.15, 0.20, 0.30 & 0.40%) and sown in RBD with three replications. M2 generation was raised in Rabi 2020-21 in M1 plant progeny rows, plants from three concentrations (0.10, 0.15 & 0.20% EMS) of M1 selected from both varieties. The analysis of variance indicated that the variation due to genotypes was significant for days to 50% flowering, days to maturity and pods/plant. The variation due to doses was significant for all the characters. The interaction between genotypes and doses was significant for seedling height, pods/plant and seeds/pod. The lethal dose 50 (LD50) based on germination in the M1 generation was 0.378% EMS in Kashi Nandini and 0.376% EMS in Kashi Uday and based on survival, it was 0.328% in Kashi Nandini and 0.336% in Kashi Uday. Pollen sterility increased with increasing the concentrations of EMS in both varieties. The seedling height and plant height decreased in all the treatments except 0.20% EMS. Flowering and maturity were delayed in all treatments with increased EMS concentrations in both varieties in M1 and M2 generations. Pods/plant and seeds/pod were more at 0.20% EMS and 0.10% EMS, respectively, in M1 generation and decreased at higher concentrations. One hundred-seed weight was more at 0.20% EMS in both varieties. Mutagenic effectiveness decreased with increased EMS concentrations. Mutagenic efficiency based on pollen sterility decreased and based on lethality increased with increased EMS concentrations. The mean performance in M2 generation showed the highest seedling height at 0.20% EMS in both varieties. Both varieties recorded the highest fertile branches, pods/plant, seeds/pod, seed yield/plant, and 100-seed weights at 0.15 and 0.20% EMS. The GCV and PCV were high for seedling height, fertile branches, pods/plant, seeds/pod in both varieties at 0.15 and

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0.20% EMS suggesting the scope of selection. The highest heritability and genetic advance were recorded for seedling height and seeds/pod1 at 0.10 and 0.20% EMS. Moderate estimates were recorded for seeds/pod with 0.20% EMS, followed by seeds/pod at 0.10% EMS and seedling height at 0.20% EMS. Desirable plants were detected for various quantitative traits in the M2 generation. These mutants showed significant differences from the controls of both the varieties in the treated populations at higher concentrations of EMS. Desirable micro mutants in M2 generation observed at 0.15, and 0.20% EMS need further evaluation in M3 generation for confirmation.

## **Efficacy of green synthesized nanoparticles against Fusarium wilt of tomato**

*Amal Jyoti Debnath*

Fusarium wilt of tomato caused by *Fusarium oxysporum* f.sp. *lycopersici* (FOL) Synder and Hansen is one of the most important and destructive diseases of tomato grown both in green house and field condition, causing considerable yield loss. The present investigation was undertaken to evaluate the efficacy of few green synthesized nanoparticles against the disease. Aqueous extract of four different medicinal plants viz., *Ocimum gratissimum*, *Piper longum*, *Wedelia chinensis* and *Homalomena aromatic* were used along with the chemical precursor for the synthesis of nanoparticles. Initially, the green synthesized nanoparticles viz., gold, nickel, zinc oxide and copper were evaluated at 1000 ppm concentration against the pathogen. Out of these, copper nanoparticle (CuNP) and gold nanoparticle (AuNP) synthesized by using leaf extract of *O. gratissimum* which exhibited considerably higher inhibition (above 90 per cent over control) on mycelial growth of the pathogen were further tested against FOL at 50, 100 and 150 ppm concentrations. The CuNP and AuNP at 150 ppm concentration showed significantly higher inhibitory effect (75.11 and 71.33 per cent) on mycelial growth of the pathogen over the control, which were further characterized. Formations of CuNP and AuNP were confirmed by UV-Vis spectroscopy study and found critical absorption peaks at 384 and 550 nm, respectively. Zeta-sizer analyses showed that both CuNP and AuNP have negative surface charge and were moderately stable in nature with zeta potential value of -22.8 mV and -22.5 mV, respectively. Dynamic light scattering analysis showed that the average size of the CuNP and AuNP were 47.09 nm and 48.78 nm with polydispersity index of 0.401 and 0.352 respectively. Transmission electron microscopy study showed that shape of the CuNP was spherical and that of AuNP was spherical to quasihedral and the size ranges below 100nm. These nanoparticles were evaluated in pot condition at 150 ppm concentration for their effect in managing the disease and were compared with copper oxychloride (COC) @ 0.3 per cent concentration. Seed and soil treatment with COC showed lowest disease incidence (13.33 per cent) and percent disease index (6.89 per cent) which was followed CuNP

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(24.00 and 13.56 per cent, respectively). This was followed by soil treatment with CuNP (76.00 and 83.60 per cent) and soil and seed treatment with AuNP (74.67 and 83.33 per cent), the effect of which were statistically at par. Growth, yield and yield attributing characters were also recorded where combined application of nanoparticles as seed and soil treatment showed the best results.

## **Root endophytes from wild banana plant and their antagonistic potential against major pathogens of malbhog banana**

*Ankita Saikia*

Malbhog banana, native to Assam and growers' and consumers most preferred variety suffers serious loss due to different diseases. On the other hand some wild banana plants show significantly lower disease load with luxuriant growth. It is hypothesized that besides the genetic make up for resistance, such germplasms may have coevolved with some beneficial microbes and harbor them as endophytes which subsequently contributes in disease suppression. In this study we explored some wild banana germplasms with luxuriant growth and lower/no disease incidence as potential source of aggressive endophytes and PGPMs. Two wild banana germplasms were identified and roots were collected for isolation of endophytes. Screening of major diseases in Malbhog banana in Horticultural orchard, AAU, Jorhat recorded Fusarium wilt and Sigatoka leaf spot as predominant diseases. Pathogens were isolated and identified with morpho-cultural characterization as *Fusarium oxysporum* and *Pseudocercospora musae* for Fusarium wilt and Sigatoka leaf spot respectively. Further race identification was done using Foc race 1 specific primer which revealed the pathogen as Race 1 of *Fusarium oxysporum* f.sp. cubense. A total of 28 root endophytic isolates (22 bacterial, 6 fungal) were recovered and subjected to preliminary screening for their antagonistic effect against the pathogens. 3 bacterial endophytes and 1 fungal endophyte were carried forward for further identification and screening for antagonism and PGP activity. Morpho-cultural, biochemical and molecular characterization revealed identity of endophytes as *Enterobacter* sp., *Bacillus amyloliquefaciens*, *B. vallismortis* and *Trichoderma harzianum*. In vitro evaluation of endophytes against *Fusarium oxysporum* f.sp. cubense showed maximum inhibition by *B. vallismortis* (79.8%) followed by *B. amyloliquefaciens* (75.6%), *Enterobacter* sp. (61.0%) and *Trichoderma harzianum* (57.3%). Among the endophytes *B.vallismortis* showed significantly higher inhibition against *Pseudocercospora musae* (85.6%) too followed by *B. amyloliquefaciens* (83.8%), *Trichoderma harzianum* (67.7%) and *Enterobacter* sp.

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(54.4%). Endophytes also showed positive results for Ammonia, HCN and Siderophore production confirming their role in suppressing pathogens as well as growth promoting ability. In planta evaluation of endophytes for their PGP activity demonstrated all the four endophytes as PGPMs with enhanced growth in terms of plant height, leaf size, girth and no. of new root emergence.

## **Efficacy of Double-Stranded RNA Inhibiting Transmission of Cucumber Mosaic Virus in King Chilli (*Capsicum chinense* Jacq.)**

*Anindita Saikia*

King chilli (*Capsicum chinense* Jacq.) is widely grown in India's NorthEastern area, primarily in the states of Assam, Nagaland, and Manipur, and is regarded as the third hottest chilli pepper. The majority of the damage in king chilli plants is caused by virus complexes, which account for up to 60-70 percent of the damage, 10- 20 percent by fungal infection, and 5-10 percent by bacterial infection. CMV induces systemic infection in the majority of host plants, however, some crops, such as alfalfa, may remain symptomless. CMV is spread in the field by aphids in a non-persistent way by over 86 aphid species and by seed in some hosts. Therefore, management of a CMV outbreak is difficult in the field. With growing worries about the environmental and human health consequences of chemical control, biologically enhanced technologies such as RNAi technology have been developed. RNA interference (RNAi) is a powerful tool for functional gene analysis that has been successfully utilised to reduce target gene expression levels. The present study undertaken whether exogenous application of dsRNAs corresponding to the viral gene of CMV could suppress the virus titer in king chilli. Samples of king chilli leaf tissue infected with CMV was obtained for this study from different king chilli growing areas in the Jorhat district, and CMV was successfully detected using a two-step reverse transcriptase PCR (RT-PCR) method employing primers specific to the coat protein gene. The coat protein gene (CP gene) was successfully isolated and cloned into the L4440 vector and transformed into DH5 $\alpha$  cells of *E. coli*. The cloning was confirmed by Restriction digestion analysis and the CMV was confirmed by sequencing. Sequence similarity of 99 percent with other sequences worldwide was revealed by the NCBI and Blast analysis. A protocol for the synthesis of dsRNA using T7 RNA polymerase was utilized to produce RNA based vaccine against the *Cucumber mosaic virus* infecting *Capsicum chinense* Jacq. CMV CP genebased dsRNA developed was further studied to standardized and compute out the best delivery ways for exogenous application of dsRNA, and a total of 16 treatments been carried out for analyzing the same. It has been found that treatment T3, T7, T9, T13, T14 and T15

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were able to effectively control CMV infection. To investigate the role of dsRNA in the transmission of CMV by aphids, a seedling experiment has been conducted. Correspondingly, it was revealed that the RNA vaccine was blocking the aphid-mediated transmission of CMV, and the vaccinated plants continue to grow normally while unvaccinated plants exhibit the typical symptoms of the disease. All of the data were verified by RT-PCR and DAS-ELISA and were statistically supported. From the conducted experiments, it is clearly demonstrated that exogenous application of dsRNA molecules of CMV-CP showed considerable reduction in percentage of CMV infection.

## **Comparative Histopathological and Protein Profiling Approach to Study Tomato Resistance against *Ralstonia solanacearum***

*Bikoseeta Saikia*

*Ralstonia solanacearum* is one of the most noxious bacterial plant pathogens, responsible for bacterial wilt disease in more than 200 plant species. The pathogen makes an entry to the plant through root natural openings or injuries. Thereafter, *R. solanacearum* invades the xylem vasculature of the plants and multiply profusely inside the xylem tissue and spread in vertical and in horizontal demeanour to the neighbouring tissues, resulting in dreadful wilting of the infected plants and eventual death. Host resistance is one of the most eco-friendly ways of managing this disease. The present study was undertaken to standardize a robust method of challenge inoculation of *R. solanacearum*, for screening of resistant tomato germplasm. Inoculation of *R. solanacearum* by soil soak method, in tomato plants, was found to be very effective in screening out resistant germplasm. Five cultivars of tomato namely, Hawaii 7996 (H7996), Arka Rakshak, Arka Samrat, Arka Ruby and Marmande were considered for a comparative study. From wilting assay, it was observed that H7996 was resistant to *R. solanacearum* Assam isolate. Arka Rakshak and Arka Samrat showed mild resistance, whereas Arka Ruby and Marmande were completely susceptible to the pathogen. In plants *R. solanacearum* load was also recorded to be highest in Marmande, followed by Arka Ruby, Arka Samrat, Arka Rakshak and least in H7996. Also, we could unravel that xylem vasculature tissue of H7996 triggered some defense responses against *R. solanacearum* namely, tylose formation, hydrogen peroxide accumulation and state of vascular lignification, that were absent or different in the susceptible cultivars. Toluidine blue staining of cross section of taproot-hypocotyl transition zone revealed that infected H7996 plants formed profuse tyloses in its xylem vessels, which were not formed in susceptible cultivars. Phloroglucinol- HCl staining showed that lignin of vasculature in H996 remained intact after infection, whereas susceptible cultivars showed a reduction in area of the vasculature and also showed a degraded state of lignification. DAB staining revealed the accumulation of hydrogen peroxide around the xylem vessels in

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H7996 upon infection, which was diminished or absent in other cultivars. Protein profiling approach in tomato plants of both susceptible (Arka ruby) and resistant cultivar (H7996) showed elevated differential accumulation of protein in infected H7996. A number of bands ranging from 30- 45 kDa were visible in infected H7996 plants, whereas such bands were not observed in Arka ruby. These anatomical and proteomic shifts may act as a hallmark of tomato immune response against *R. solanacearum*, which can be vital while exploring tomato resistant germplasms.

## **Molecular detection and identification of soybean viral mosaic disease in Assam**

*Bishakha Deb*

Soybean, the golden bean of 21st century and a major legume and oilseed crop contributes significantly to country's economy thus making it a highly valued crop. The crop is subjected to many biotic and abiotic agents and thereof resulting decrease in its production. Among the biotic agents, plant viruses are decreasing the productivity efficiency of the crop. Yellow mosaic disease caused by a wide variety of viruses has been reported to cause significant yield loss worldwide. In this study we aimed at molecular detection of the viruses causing the mosaic disease in the soybean fields of ICR farm, AAU, Jorhat. Mungbean yellow mosaic virus (MYMV) and Cowpea mild mottle virus (CPMMV), both transmitted by whitefly, *Bemisia tabaci* were successfully detected using gene specific primers. MYMV, a Begomovirus was amplified with a primer targeting the coat protein region of the virus generating an amplicon size of 524bp. CPMMV, a Carlavirus was first confirmed using Carlavirus specific universal primers revealing an amplicon size of 940nt followed by CPMMV specific primer yielding an amplicon size of 216bp. Both the viruses caused a wide range of symptoms varying from leaf mosaic, mottling and puckering. The viruses were sequenced which showed 96-95% identity with other sequences of India and the world. The MYMV-Jorhat isolate was distinct from other isolates of India, while CPMMV-Jorhat isolate showed similarity with CPMMV- Kanpur isolate and slight divergence from other isolates of the world. 38 genotypes of Inter Varietal Trial were screened for the presence of virus based on distinct viral symptomology and the results on the basis of disease incidence and disease severity indicated the presence of moderately susceptible to resistant genotypes under natural conditions. Among the genotypes screened, the disease incidence varied from 1.67%-70%, while AUKS 207 was the most susceptible genotype and DSb-38 the most resistant one. Analysis of variance and estimation of genetic variability parameters based on quantitative data revealed the high heritability traits to be selected for future breeding programme to escape the disease incidence. The detection the viruses in the region plays an important step in the management aspect of the crop.

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## **Organic management of Pest and Diseases in Potato**

*Debarshi Patowary*

In the present investigation, efforts have been made to evaluate the comparative efficacy of two different forms of copper fungicides viz., copper oxychloride and copper hydroxide against late blight of potato incited by *Phytophthora infestans* (Mont.) de Bary under the different spray schedule (10 numbers of sprays at 4 days interval and 8 numbers of sprays at 5 days interval) with a view to select the most effective one for management of the disease. Field experiment performed revealed that both the fungicides could control late blight to a varying extent. Among the fungicides, copper hydroxide proved to be the best in reducing late blight severity. The fungicide could provide highest protection (73.74%) to moderately late blight resistant variety (Kufri Himalini) and 47.23% protection to the susceptible variety (Kufri Jyoti) when applied 10 numbers spray of copper hydroxide @0.2% at 4 days interval. This treatment gave maximum tuber yield 15.73 and 10.26 t/ha in K. Himalini and K. Jyoti respectively. Although maximum net return Rs. 54,200 with a corresponding incremental benefit-cost ratio of 2.25 was recorded in this treatment (10 numbers spray with copper hydroxide @0.2% at 4 days interval) but at the same rate of application the highest B:C ratio (2.41) obtained in the treatment of copper oxy-chloride with a net return of Rs. 43,500. An another study on comparative efficacy of four microbial bioformulations viz., Biometta, Biosona, Biolium and Biogreen against Red ant (*Dorylus orientalis* Westwood) on potato was evaluated during 2018-2019 and 2019-2020. The formulation, Biosona (combined tuber treatment @6g/kg tuber and soil application with enriched compost @ 2 t/ha) gave highest tuber yield of 11.23 t/ha with a minimum infestation rate of 15.71% tuber damage and maximum protection (47.02%) against red ant and also gave a satisfactory profit of Rs. 19,700 with a B:C ratio of 1.48. The third investigation was carried out during 2018-2019 and 2019-2020 to evaluate the comparative efficacy of four microbial bio-formulations viz., Biometta, Biosona, Biolium and Biogreen against Aphid (*Myzus persicae* and *Aphis gossypii*) on potato. Biolium (*Verticilium lecani*) @0.5% spray gave highest tuber yield of 10.27 t/ha with a highest protection 33-66 % against aphid. This treatment gave a satisfactory profit of Rs. 10,400 with a B:C ratio of 1.44.

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# **Epidemiological Studies and Molecular Characterization of *Alternaria* spp. Infecting Cabbage in Assam**

*Jangila Hazowary*

The lower productivity of cabbage in Assam is mainly due to the attack of diseases viz., leaf spot and blight, damping off and black rot. Yield loss of up to 70% was reported due to the leaf spot and blight caused by *Alternaria brassicae* and *A. brassicicola*. The environmental variables viz., maximum temperature, minimum temperature, relative humidity, rainfall and bright sunshine hours affect the per cent disease intensity. The higher pathogenic diversity of *A. brassicae* and *A. brassicicola* is one of the hindrances to the development of resistant varieties. The present study was conducted to find out the correlation between disease intensity and different environmental factors and also develop a mathematical model among the factors and disease intensity for effective management. Molecular characterization of *Alternaria* sp. was also studied to find out the different races prevalent in major cabbage growing districts of Assam. The study revealed that the date of transplanting plays a significant role in disease intensity. The highest AUDPC was observed in December transplanted crop (1317.75) followed by February transplanted crop (1037.85). Similarly, the PDI was also found to be the significantly lowest in October transplanted crop (PDI=12.21 at 75 DAT) and the highest in December transplanted crop (PDI=27.33 at 75 DAT). With respect to the correlation matrix, a significant positive correlation with PDI was observed in the case of relative humidity and rainfall. Maximum temperature, minimum temperature and bright sunshine hours showed a negative correlation. The combined effect of all the environmental factors in disease development was 63.19 to 82.94 as indicated by the multiple regression equation. Simple linear regression also showed the effect of different environmental factors on disease development ( $r^2$  value = 0.6748-0.9794). All the growth parameters, as well as yield, were found better in October transplanted crop and the lowest in February transplanted crop. A negative correlation was also observed with all growth parameters and yield with the PDI. The morphological studies viz., dimension of conidia, under microscope confirmed that all the pathogen isolated from the different major growing districts of Assam was *A.*

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*brassicicola*. The molecular characterization study with RAPD indicated the lowest genetic distance between the isolates of Jorhat (AbJor\_2) and Barpeta (AbBa\_1; Kokrajhar (AbKok\_3 and AbKok\_1); Jorhat (AbJor\_1) and Kokrajhar (AbKok\_2). The dendrogram generated from similarity data revealed five clusters of isolates out of which the single isolates from Nagaon (AbNag\_2) were found to be an outlier.

## **Identification, characterization and management of pumpkin mosaic disease**

*Kulumanali Gogoi*

The present investigation was conducted for identification, characterization and management of pumpkin mosaic disease in Assam. A roving survey was conducted during 2019-2021 in Jorhat, Golaghat, Karbi Anglong, Biswanath Chariali and Charaideo to determine the disease incidence through symptomatology, vector population count and detection of the viruses associated with mosaic disease of pumpkin through serodiagnostic (DAS-ELISA) and molecular assay (PCR and RT-PCR). Symptomatology revealed various degrees of mosaic, mottling, vein clearing, vein banding, chlorosis, leaf distortion, small, crinkled, deformed leaves and malformed fruits with mosaic and chlorotic spots resulting in reduced yield and production. Serological detection through DAS-ELISA confirmed the association of Cucumber mosaic virus (CMV) in CMV suspected pumpkin samples. The DAS-ELISA assay revealed disease incidence of 52.38 per cent in Golaghat district and 35.71 per cent in Jorhat district. Two different types of aphid vectors viz., *Aphis gossypii* and *Myzus persicae* were observed in all the surveyed locations. Total genomic RNA extracted from symptomatic and asymptomatic pumpkin plants were subjected to RTPCR assays using CMV, zucchini yellow mosaic virus (ZYMV) and watermelon mosaic virus (WMV) specific primers and Deng universal primer for detection of begomovirus viz., pumpkin yellow vein mosaic virus (PYVMV). RT-PCR assay revealed the presence of CMV in the samples which yielded the desired amplicon size of 593 bp. No amplification was obtained from the samples for ZYMV and WMV. PCR product of CMV infected sample from Jorhat district viz., CMV-CP Jorhat isolate was sequenced and compared with the known CMV isolates worldwide using nucleotide BLAST programme at National Centre for Bio Informatics (NCBI) and Mega X software. The sequence similarity of CMV-CP Jorhat isolate ranged from 93.11 per cent to 99.16 per cent with worldwide CMV isolates. A field experiment was conducted for management of pumpkin mosaic disease through integrated approach. It was evident from the field experiment that there was low disease incidence with low vector population as well as high yield in the treatments of hot water seed treatment at 50°C for 10 minutes and

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spraying of neem formulation @3ml/lit at 15, 30, 45 and 60 days after transplanting (T1) followed by hot water seed treatment at 50°C for 10 minutes and spraying of Imidacloprid @2ml/lit at 15, 30, 45 and 60 days after transplanting (T6) than the other treatments with the highest yield (80.00 q/ha) recorded for the treatment T1 with highest per cent reduction of disease over control (53.22 per cent).

## **Taxonomic study on fungal flora associated with medicinal plants of Assam**

*Longkiri Rongpi*

Medicinal plants constitute an important natural wealth of the world. The use of medicinal plants as dietary supplements or as therapeutics were recorded from the time immemorial but demand for the medicinal plants is presently expanding in both developed and developing countries. Assam, due to its diverse agro-climatic conditions becomes a potential hub for cultivation of different medicinal plants. However, a huge amount of these valuable plants get ruined because of the biotic stresses. Therefore, for effective management of these biotic stresses their causal organisms need to be identified, characterized and studied thoroughly. The taxonomic studies on the fungal flora associated with the medicinal plants were least reported from Assam and NorthEastern region of India. The present investigation was made to isolate and identify the fungal flora associated with few medicinal plants of Assam and to determine the taxonomic position of the pathogenic fungal isolates. A total of thirteen diseased samples of medicinal plants were collected from different locations of four major districts of Assam viz., Jorhat, Golaghat, Nagaon and Karbi Anglong. Thirteen fungal isolates viz., LR1Sg1, LR2P1, LR3M1, LR4C1, LR5Sg2, LR6Sg3, LR7P2, LR8M2, LR9C2, LR10SP, LR11Gi, LR12T1 and LR13T2 were isolated from seven medicinal plants. These thirteen fungal isolates were identified on the basis of their morphological, cultural and molecular characters. The isolate LR1Sg1 isolated from Homalomena aromatic (Sugandh Mantri) was identified as *Curvularia lunata*, LR2P1 isolated from *Piper longum* (Pipli) as *Phoma eupyrena*, LR3M1 isolated from *Centella asiatica* (Manimuni) as *Acremonium alternatum*, LR4C1 isolated from *Costus speciosus* (Costus) as *Acremonium zonatum*, LR5Sg2 isolated from Homalomena aromatic (Sugandh Mantri) as *Ascochyta rabiei*, LR6Sg3 isolated from Homalomena aromatic (Sugandh Mantri) as *Fusarium oxysporum*, LR7P2 isolated from *Piper longum* (Pipli) as *Acremonium fusidioides*, LR8M2 isolated from *Centella asiatica* (Manimuni) as *Fusarium oxysporum*, LR9C2 isolated from *Costus speciosus* (Costus) as *Colletotrichum gloeosporioides*, LR10SP isolate from *Rauvolfia serpentina* (Sarpagandha) as *Acremonium strictum*, LR11Gi isolated from *Tinospora cordifolia* (Giloy) as

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Colletotrichum gloeosporioides, LR12T1 isolated from Ocimum sanctum (Tulsi) as Acremonium strictum and LR13T2 isolate from Ocimum sanctum (Tulsi) as Phoma terrestris. Out of these, seven fungal species viz., Curvularia lunata, Phoma eupyrena, Ascochyta rabiei, Colletotrichum gloeosporioides, Acremonium strictum, Colletotrichum gloeosporioides and Phoma terrestris could reproduce the specific symptoms in their respective host, hence were proved pathogenic. All these seven pathogenic fungal species constitutes new host record for Assam and India.

## **Management of contamination of *Trichoderma* spp. in oyster mushroom bed with botanicals**

*Mallikarjun Channappa Chitti*

Green mould contamination is a major obstacle in oyster mushroom cultivation worldwide. The mushroom industry in Assam is under serious threat due to this dreaded fungus. The present study was undertaken to manage the contaminant by using a few botanicals in vitro. The isolated contaminant was identified as *Trichoderma asperellum* based on cultural, morphological and molecular characterization of the fungus. The effectiveness of botanicals against *T. asperellum* was evaluated using poison food technique. The aqueous extracts of nine botanicals were evaluated at 15 per cent concentration in vitro for their effectiveness against the contaminant. Out of nine botanicals, *Allamanda cathartica* (66.28%) and *Eucalyptus globulus* (62.82%) showed significantly highest inhibition on mycelial growth of *T. asperellum* (above 60 per cent), which were chosen for further studies. These two most effective botanicals were again evaluated against *T. asperellum* at three different concentrations (5, 10 and 15 per cent). Amongst the botanicals, the leaf extracts of *A. cathartica* at 15 per cent concentration showed maximum inhibitory effect on the mycelia growth of *T. asperellum* as compared to control followed by *E. globulus* at 15 per cent. This was followed by *A. cathartica* at 10 per cent concentration. The least inhibition was recorded with 5 per cent concentration of *E. globulus*. In the compatibility test with *Pleurotus sajor-caju* mushroom in vitro, both the botanicals were found to enhance the mycelial growth of the mushroom. In *Pleurotus sajor-caju* mushroom beds, the green mould fungus, *T. asperellum* was also found to be managed by spraying both the botanicals viz., *A. cathartica* and *E. globulus* at three different concentrations (5, 10, and 15 per cent) at the time of spawning and opening of the beds. The maximum yield (0.728 kg) was recorded in the mushroom bed treated with *A. cathartica* at 15 per cent concentration and showed minimum incidence of contamination (21.28%) compared to control. The influence of botanicals for mycelium run and pin head formation (in days) were found to be faster in the beds treated with *A. cathartica* at 15 per cent concentration. The effect of botanicals on the average stipe length, stipe diameter and cap size were also found highest in the mushroom beds treated with *A. cathartica* at the same concentration as compared to the control.

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## Characterization of Microbial Load in Different Types of Made Tea

*Mirjeng Ronghang*

Tea is one of the most popular beverages consumed widely next to water. But the exposure of tea leaves to microbial contamination at all stages starting from processing to storage poses a threat to human health. Hence the present study aimed to assess and characterize the microbial load and check the safety of a cup of tea. Tea samples were collected from different tea estates in Upper Brahmaputra Valley Zone, Barak Valley Zone, and North Bank Plain Zone. Also, loose, and packed market samples were collected from the shops of Jorhat to evaluate the microbial contamination of the made tea samples. North Bank Plain Zone showed the highest bacterial count (529.52 cfu/g), while Barak Valley showed the highest fungal count (79.72 cfu/g), and the least bacterial (346.58 cfu/g) and fungal count (53.64 cfu/g) was found in Upper Brahmaputra Valley Zone. *Escherichia coli* colonies were found only in Barak Valley Zone (7.78 cfu/g) and North Bank Plain Zone (57.62 cfu/g). In the case of the market samples, loosemade tea samples showed the highest bacterial count (735.76 cfu/g), and packed-made tea samples showed the highest fungal count (226.11 cfu/g), whereas *E. coli* colonies (127.27 cfu/g) were found only in the loose-made tea samples. No microbial contamination was found in any of the made tea infusions after boiling. The microbial load of the made tea samples was found under acceptable levels both before and after boiling, except for *E. coli* which was found at acceptable only after boiling. Morphological, cultural, and molecular characterization was carried out to identify the prominent isolates obtained from the made tea samples. The fungal isolates were identified as *Aspergillus aculeatus*, *Aspergillus flavus*, *Aspergillus nidulans*, *Aspergillus niger*, *Cladosporium cladosporioides*, and *Penicillium expansum*. The bacterial isolates were identified as *Bacillus anthracis*, *Bacillus cereus*, *Bacillus pumilus*, *Pantoea* sp., *Proteus mirabilis*, and *Escherichia coli*. From the present study, it can be concluded that the made tea of Upper Brahmaputra Valley Zone, Barak Valley Zone, and North Bank Plain Zone as well as the market-made tea samples are safe for drinking by proper boiling as the microbial loads were found under an acceptable level.

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## **Cultural, morphological and molecular variability among isolates of *Rhizoctonia solani* causing Web Blight of Green gram (*Vigna radiata* (L.) Wilczeik)**

*Mohana Pradeep R K*

Web blight of green gram is one of the major constraints which incur huge losses and hold back the production of green gram in Assam. A comprehensive study was made during 2020-21 on the variability of *Rhizoctonia solani* isolates based on morphocultural characteristics and molecular variation. Web blight infected plants were collected from different geographical locations was designated as SH-1, SH-2, AAU-1, TT-1, and MJ1 and identified based on a typical character with right angle branching near the distal septum of the young vegetative hyphae. A high virulence pattern for all the isolates was recorded based on pre-emergence seedling rot and complete leaf blighting appearance within 48 hours of inoculation in susceptible cultivar (SGC-16). All the five isolates showed variation in morpho-cultural characteristics such as colony growth diameter, colony texture, concentric rings on radial growth, colony color, growth pattern, hyphal width, distribution pattern of sclerotia, sclerotial initiation, maturation, color, aggregation, exudate droplets on sclerotial surface, position of sclerotia and sclerotia on lid, sclerotial diameter, number and weight in different growth media Potato Dextrose Agar (PDA), Rose Bengal Agar (RBA), Richard's Agar (RA), Czapeck's Dox Agar (CDA) and Sabouraud Dextrose Agar (SDA) where most of the isolates were categorized into three and four groups based on hyphal width and sclerotial initiation respectively. The size, number, and weight of sclerotia were highly variable across different isolates concerning media. They are arranged in the central, centralperipheral, sub-central, sub-central peripheral, peripheral and scattered manner on the petridish with respect to media. Among different media, Sabouraud Dextrose Agar medium (85.85%) is the best growth media to study morpho-cultural variability with quantitative variables like sclerotial maturation and initiation which directly correlated with virulence of our *R. solani* isolates based on principal component analysis. There is no evidence of molecular variability among our isolates from different geographical locations of Assam.

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# **Rhizospheric Microbes in *Phytophthora* Infected vs. Healthy Khasi Mandarin Plants (*Citrus reticulata* Blanco.) and Evaluation of Native Bioagents**

*Mridupol Handique*

*Phytophthora* diseases characterized as gummosis, brown rot, root rot are considered as a major challenge for citrus industry worldwide owing to the perennial nature of the crop coupled with the soil borne pathogen invading the host system makes management practice a formidable challenge. Suppressing soil or healthy plants in a diseased plantation naturally keeps inoculum at minimal level providing a strong base to explore the native bioagents as effective management strategy. The present study was undertaken to identify *Phytophthora* spp. associated with Khasi mandarin in Assam, diversity analysis of microbial community composition to identify beneficial antagonistic microbes associated with healthy rhizosphere against the pathogen. Survey was made in 8 khasi mandarin orchards and 3 fields (Khaman Pathar, Motapung and Kamalabari) were identified as *Phytophthora* infected based on characteristic symptoms gummosis, root and foot rot. The three isolates were identified as *P. nicotianae* based on morpho-cultural characteristics and validated their association with the disease through pathogenicity test. Microbial diversity expressed as Shannon-Weiner diversity index revealed higher value in the *Phytophthora* infected khasi mandarin rhizosphere as compared to the healthy rhizosphere. Among culturable fungi, *Fusarium* spp., *Penicillium* spp., *Aspergillus* spp., *Acremonium* spp., *Mucor* spp., *Geotrichum* spp., *Culvularia* spp. were recovered from both the samples. Whole metagenome sequencing analysis of fungal ITS and bacterial 16SrRNA unravelled abundance of *Phytophthora* in diseased soil higher than in healthy soil as well as greater abundance of Ascomycota, Basidiomycota and Zygomycota in both the soil. *Fusarium* and *Penicillium* were the most dominant fungal genera in both the soils, however, abundance of *Penicillium* was greater in healthy soil (21.02%) than diseased soil (2.56%). Relative abundance of bacteria showed greater abundance of Pseudomonas, Flavobacteria, Bacteroidetes and *Bacillus* in healthy rhizosphere. Preliminary screening of the culturable microbes from healthy rhizosphere showed efficacy of 8 fungal and 5 bacterial isolates against *P.*

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*nicotianae* with more than 50 per cent mycelial inhibition of *P. nicotianae*. Morpho-cultural and molecular characterization of promising isolates identified them belonging to two genera *Trichoderma* (*Trichoderma asperellum* DamT22, *T. asperellum* CST1, *T. asperellum* CST3, *T. asperellum* CST5, *T. harzianum* NAG, *T. asperellum* KOT22, *T. asperellum* BH3, *T. harzianum* BH4) and *Bacillus* (*Bacillus amyloliquefaciens* BAC-MH105, *B. subtilis* MH-JB5-BAC, *B. velezensis* MH4-22, *B. amyloliquefaciens* BAC 1, *B. velezensis* BAC 3) as citrus rhizosphere specific antagonists. The antagonists were further screened in vitro which revealed greater efficacy of Bacterial antagonists with 76.33 to 72.09 per cent inhibition of *Phytophthora* spp. than fungal isolates (70.07-54.16 per cent). Among bacterial antagonists *Bacillus velezensis* MH4-22(76.78%) was reported most efficient followed by *B. subtilis* MH-JB5-BAC (75.44%). *Trichoderma asperellum* CST3 among all the *Trichoderma* showed maximum inhibition of the pathogen (70.07%) followed by *T. asperellum* BH3 (69.12%). The study revealed complex interaction of citrus phyto-biome with the *Phytophthora* diseases in Khasi mandarin and showed *Trichoderma* spp. and *Bacillus* spp. as putative microbes playing pivotal role in suppressing the pathogen under natural ecosystem.

## **Compatibility Studies of Bio-Control Agents with Agrochemicals and Their Effect on Non-Target Insects of Vegetable Cropping System**

*Pooja Bharadwaz*

Most of the farming population is mainly dependent upon synthetic agrochemicals in order to avoid food losses caused by the abundant number of pests and diseases. But due to excessive use of these synthetic chemicals, they have gained resistance against pests and pathogens and this has led to residual effects of these chemicals on the environment. With the view, along with reducing the load of agrochemicals, a well-organized sustainable agricultural production system is very much needed to feed the ever-increasing global population. Further, the natural enemies are a boon to the environment so their compatibility with the bio-pesticides used in the farmers' field also needs to be considered. Therefore, an in-vitro study was conducted to check the compatibility of 4 bio-control agents (*Trichoderma viride*, *Trichoderma harzianum*, *Bacillus subtilis*, and *Pseudomonas fluorescens*) against 22 commonly used agro-chemicals (8 insecticides, 7 fungicides, 2 herbicides, 3 fertilizers, and 2 antibiotics) at 100ppm, 500ppm, 1000ppm, and 2000ppm concentrations. All 4 biocontrol agents showed good compatibility with Imidacloprid 27.8% SL, Diafenthiuron 50% WP, Chlorantraniliprole 18.5% SC, Flubendiamide 20% WG, Azoxystrobin 23% SC at all the 4 concentrations. *T. viride* and *T. harzianum* showed compatibility with some other agro-chemicals, viz., Deltamethrin 2.8 % EC, Clothianidin 50% WDG, Glyphosate 41% SL, SSP, Streptomycin, and Gentamycin at all the 4 concentrations. Similarly, *B. subtilis* and *P. fluorescens* showed compatibility with some other agrochemicals, viz., Thiamethoxam 25% WG, Hexaconazole 5% EC, Propiconazole 25% EC, and Tebuconazole 25.9 % EC. Agro-chemical, Fenpropathrin 10% EC showed compatibility with all 4 bio-control agents up to 1000ppm. All other agro-chemicals showed varying degrees of compatibility, viz., Thiamethoxam 25% WG, Urea and MOP with *T. viride* and *T. harzianum* up to 500ppm; Deltamethrin 2.8 % EC, Chlorothalonil 75% WP and Tebuconazole 50% + Trifloxistrobin 25% WG with *B. subtilis* and *P. fluorescens* up to 500 ppm; Copper Oxychloride 50% WP with *T. harzianum* up to 100ppm and Clothianidin 50% WDG with *B. subtilis* and *P. fluorescens* up to 100 ppm, respectively.

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Incompatible reaction was shown by Hexaconazole 5% EC, Propiconazole 25% EC, Tebuconazole 25.9 % EC, and Tebuconazole 50% + Trifloxistrobin 25% WG with *T. viride*, *T. harzianum* and by Copper Oxychloride 50%WP, Glyphosate 41% SL, Paraquat Dichloride 24% SL, Streptomycin, and Gentamycin with *B. subtilis* and *P. fluorescens* at all 4 concentrations. Similarly, Copper Oxychloride 50% WP showed an incompatible reaction with *T. viride* at all 4 concentrations. In another study on the effect of various biopesticides, viz., Bioveer, Biozium, Biomonas, Biobt, Biosona, Biometa, Biollium, Biotime, and Biogreen-5, developed by the Department of Plant Pathology, AAU, Jorhat at their recommended doses both in field and pot condition didn't show any detrimental effect on the population of natural enemies, coccinellids.

## **Bio-Efficacy of Plant Growth Promoting Rhizobacteria against *Fusarium oxysporum* f.sp *lycopersici***

***Lopamudra Giri***

Tomato (*Solanum lycopersisi* L.) is one of the most commonly cultivated and commercially important vegetable crops in the world belongs to the family Solanaceae. The crop is affected by several diseases among which Fusarium wilt caused by *Fusarium oxysporum* f.sp *lycopersici* is one of the most important constraints to tomato production in major tomato growing areas in the world. The present study was conducted to evaluate the efficacy of rhizobacterial isolates of tomato against the *Fusarium oxysporum* f.sp *lycopersici*, their identification and characterization and to assess their growth promoting traits. A total of 216 rhizobacterial isolates were isolated from the root zone of healthy and profusely growing tomato plant of 17 different locations which belongs to six agroclimatic zones of Assam. Out of these, 20 rhizobacterial isolates were selected based on their in vitro preliminary efficacy test against the pathogens, which were further tested by dual culture technique. The result showed that, six rhizobacterial isolates which were coded as LMGL11, LMGP1, LMGD10, LMGH4, LMGT2 and LMGK2 were most effective in inhabiting the mycelial growth of the *Fusarium oxysporum* f.sp *lycopersici*, were selected for further studies. On the basis of molecular studies the isolate LMGL11 was identified as *Bacillus cereus*, LMGP1 as *Pseudomonas aeruginosa*, LMGD10 as *Clostridium* sp., LMGH4 as *Lysinibacillus fusiformis*, LMGT2 as *Bacillus cereus* and LMGK2 as *Achromobacter xyloxydans*, respectively. Morphological studies showed that all the rhizobacterial isolates were gram positive and rod shaped except *Pseudomonas aeruginosa*, and *Achromobacter xyloxydans* which were gram negative. Biological analysis revealed that *Pseudomonas aeruginosa* (LMGP1), *Clostridium* sp., (LMGD10), *Lysinibacillus fusiformis* (LMGH4) and *Achromobacter xyloxydans* (LMGK2) were positive for IAA production, ammonia production, phosphorus solubilization and siderophore production. *Bacillus cereus* (LMGL11) was found positive for IAA production, ammonia production, and siderophore production, whereas *Bacillus cereus* (LMGT2) for the production of IAA and ammonia.

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**Major Adviser: Dr. Daisy Senapoty**

## **Studies on biocidal activities of endophytes isolated from chilli against fruit rot pathogen of Bhut Jolokia (*Capsicum chinense* Jacq.)**

*Partha Pratim Sarmah*

Bhut Jolokia (*Capsicum chinense* Jacq.), an ethnic crop to the people of the northeast which possessed immense potential and scope for entrepreneurs. The higher amount of capsaicin content and a Scoville rating of 1,001,304 SHUs made it certified as one of the hottest chillies in the world. The crop's productivity is always challenged by various diseases, one of which is the fruit rot disease. Due to a lack of sustainable management strategy and over-dependence on synthetic chemicals, the economic benefits of the crop were never realized. Searching for a management strategy through biological control, the present study was made to explore the endophytic microflora residing in chilli plants and to evaluate their efficacy against fruit rot pathogen. The incitant pathogen of the fruit rot of Bhut Jolokia was identified and confirmed as *Colletotrichum gloeosporioides* based on cultural, morphological and molecular studies. A total of 34 endophytic isolates including 31 bacterial and 3 fungal were isolated from healthy leaf, stem, fruit and root of four different chilli cultivars. On morphological, biochemical, and molecular identification, the four promising bacterial isolates PBEDL1, PJE5B, PGE4B and PM5A selected based on preliminary screening were identified as *Bacillus valezensis*, *Bacillus mycoides*, *Bacillus altitudinis* and *Bacillus cereus*, respectively and used for further in vitro evaluation. *Bacillus valezensis* showed the highest inhibitory effect (68.67 %) on the mycelial growth of the *C. gloeosporioides* over the control followed by *Bacillus mycoides* (65.33 %), *Bacillus altitudinis* (52.89%) and *Bacillus cereus* (45.33 %). Among the compatible combination, the highest efficacy (56.00%) on mycelial growth inhibition was found on the combination of *B. valezensis* + *B. altitudinis* followed by *B. valezensis* + *B. cereus* (48.22%), and *B. cereus* + *B. altitudinis* (44.67%).

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**Major Adviser: Dr. Hiranya K. Deva Nath**



## **Microbe based management of citrus canker disease vis a vis prevailing weed flora**

*Pinkumoni Bokotial*

Citrus canker disease as well the weed flora of citrus grove decrease the quality and quantity of the citrus fruit. An eco-friendly approach for management of Citrus canker disease vis a vis prevailing weed flora was attempted using bioactive microorganisms, *Pseudomonas fluorescens* and weed pathogens. In the assessment of weed composition, two weeds, *Alternanthera philoxeroides* and *Commelina benghalensis* were found to have highest population density of 83% and 25% in the field condition with visible disease symptoms. From the cultural and morphological study of these two isolates, they showed their similarity with *Nimbya alternantherae* and *Colletotrichum siamense*. The molecular characterization of these microorganisms was made to determine their distinctiveness from their close relatives through sequencing of ITS region of ribosomal DNA. Interactive action of these two weed pathogen with *P. fluorescens* resulted in the partial compatibility of *P. fluorescens* with *Nimbya alternantherae* and incompatibility reaction in all other possible treatment combinations in vitro. The antagonistic potential of these compatible microbes was tested in vitro singly or in combination and per cent inhibition of target pathogen, *Xanthomonas citri* pv. *citri* were recorded and analyzed. Highest inhibition (30.00 %) of *X. citri* pv. *citri* was recorded against *P. fluorescens* and *N. alternantherae* followed by *P. fluorescens* (18.52%) in vitro. In the field study, highest citrus canker disease reduction (21.85%) was recorded in the treatment of *P. fluorescens* followed by treatment comprising of *P. fluorescens* and *N. alternantherae* (14.61%). In case of management of *Alternanthera philoxeroides* weed in field condition, highest percent disease increase (77.49% in manual analysis and 69.98% in AI analysis) was recorded against treatment of *N. alternantherae* followed by treatment comprising of *P. fluorescens* and *N. alternantherae* (41.63% in manual analysis and 45.95% in AI analysis). Correlation studies revealed positive linear relationship between manually and AI analysed data.

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## **Integrated management of the viral disease complex in Bhut jolokia (*Capsicum chinense* Jacq.)**

*Princy Khaidem*

Bhut Jolokia (*Capsicum chinense* Jacq.) is one of the important spice crops which is mainly cultivated in the Northeastern region of India. Owing to its traditional importance, pharmaceutical applications, and high commercial value, Bhut Jolokia is getting importance but the production of the crop has been hindered attributable particularly due to the infection of a number of viruses. With the growing need for proper management approaches for managing the viruses infecting the crop, a number of management strategies have been studied in the present investigations to manage the viral diseases in Bhut Jolokia. Hot water treatment was given to CMV-infected Bhut Jolokia seeds under different temperature regimes and periods. Thermotherapy was observed to be highly significant in reducing the virus infectivity. Bhut jolokia seeds treated at 50°C for 120 minutes was observed to be the best treatment with minimum disease incidence (26.08%), followed by 55°C for 60 minutes and 55°C for 120 minutes. It was recorded that the virus infectivity gradually reduced at higher temperature with longer exposure period, but, the germination rate was declined. The effect of SAR activating chemicals viz., Salicylic acid (SA), a key signalling molecule triggering plant resistance, and Benzothiadiazole (BTH), an analogue of SA were tested on CMV-infected Bhut Jolokia seeds to see their effect in the disease incidence. Foliar application of Salicylic acid and Benzothiadiazole at three different concentrations @200, 300 and 400 ppm each was tested where BTH @ 400ppm and SA @ 300 and 400ppm were recorded to be the best among all the treatments displaying less severe symptoms with 55.56 per cent disease reduction over control. Field study was conducted to evaluate the integrated effect of management practices like nursery net cover of seedlings, Benzothiadiazole @ 300 ppm with Biometa @ 5% and neem oil @ 5ml/L; Salicylic acid @ 300 ppm with Biometa @ 5% and neem oil @ 5ml/L; Biometa @ 5% and neem oil @ 5ml/L; Biometa @ 5% and Nuvan @ 1ml/L and sticky traps in different treatment combinations in the management of the viral disease infecting Bhut Jolokia. The plants were observed to be naturally infected by CMV and PVY, ChLCV forming a viral disease complex. DAS-ELISA, RT-PCR, and PCR were used for molecular detection of the viruses. The infected plants exhibited a wide range of symptoms such as severe

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mosaic, filiform, curling, and crinkling of leaves with a reduction in size, stunted plant growth with bushy appearance, fewer flowers, and deformed fruits were exhibited at later stages of plant growth. Incidence of the viral disease complex of CMV, PVY, and ChLCV ranged from 20.80 to 47.23 percent different treatments. The treatment combination T1 with Net cover of seedlings + Sticky trap +Benzothiadiazole @ 300 ppm at 2-3 leaf stage at 3 days interval for 3 times + Bio-Meta @ 5% at 60, 90 and 120 DAT+ Foliar spray with neem oil @5ml/L at 10 days interval from 30 DAG for 5 times was found to be the most effective treatment by delaying the number of days to the first appearance of symptoms with the lowest disease incidence of 20.80 per cent, maximum yield of 3.22 kg/4.5 m<sup>2</sup> , and highest benefit-cost ratio of 8.56:1.

# **Incidence, Characterization and Integrated Management of Cucurbit Mosaic Disease**

*Puja Dey*

The cucurbits belong to the family Cucurbitaceae (gourd family) under the order Cucurbitales which include many economically important vegetable and fruit species. Among various biotic factors, viruses are the important factors reducing in quantity as well as quality of cucurbits. These crops are severely affected by the cucurbit mosaic disease worldwide, which is the most important viral disease of the cucurbits. Considering the importance of the disease, the present investigation was taken up for incidence, characterization and integrated management of cucurbit mosaic disease with 3 objectives, viz. (i) Incidence, detection and host range study of cucurbit mosaic disease in Assam, (ii) Characterization of virus causing cucurbit mosaic disease, (iii) Integrated management of cucurbit mosaic disease on cucumber. Survey was conducted in 5 districts of Assam (Sonitpur, Biswanath, Jorhat, Sivasagar, Dibrugarh) during 2021-22. Symptomatology revealed presence of various mosaic symptoms in the surveyed areas and presence of aphid vectors were observed. Molecular analysis showed presence of Cucumber mosaic virus (CMV) in the samples collected from surveyed areas. A field experiment was conducted in the Experimental field, Department of Plant Pathology, BNCA, AAU for integrated management of cucurbit mosaic. In the field treatments, Treatment T6 (nursery seedling raising, straw mulching, using yellow sticky traps + foliar spraying with Imidacloprid @0.2ml/L at 30, 45, 60 and 75 days after planting) showed lowest disease incidence (22.22%) and highest yield (38.55q/ha) as compared to other treatments followed by treatment T2 (T1 + spraying of neem formulation; viz., Azadirachtin 0.03% @ 5 ml/L at 30, 45, 60 and 75 days after transplanting) with low disease incidence (38.89%) and yield of 32.83q/ha.. Lowest yield was obtained from T0 (control); i.e., 3.09q/ha. Mosaic disease incidence was also lower in the treatments where nursery seedling raising, straw mulching, yellow sticky traps were used with bio control agents; viz., *Beauveria bassiana* (T4) and *Bacillus thuringiensis* (T5) with yields of 26.96q/ha and 20q/ha, respectively. The cost benefit ratio was highest for treatment T6 (1.24:1) followed by treatment T2 (1.02:1). The correlation analysis showed that the

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yield of cucumber was negatively correlated with cucurbit mosaic disease incidence with coefficients of correlation for disease incidence and yield was -0.969 (\*\*Significance at 1 per cent probability level).

## **Studies on occurrence and organic management of anthracnose of black pepper in nursery**

*Rajshree Verma*

Black pepper (*Piper nigrum* L.) also called as “Black gold”, occupies a noteworthy position in spice industry. Black pepper anthracnose, caused by *Colletotrichum gloeosporioides* (Penz.) Penz. and Sacc. is the widespread and emerging disease in Assam, effecting vines in the nursery as well as in field. Study on natural occurrence was done by correlating weather factors such as, rainfall, number of rainy days, relative humidity, bright sunshine hours and temperature with disease incidence in nursery. It was inferred that, rainfall, number of rainy days, relative humidity and minimum temperature have significant positive correlation, while maximum temperature and Bright sunshine hours have negative correlation with the disease incidence. The disease incidence was prevalent at high levels during the monsoon period (June 2020-August 2020). Another investigation was conducted in September 2020-December 2020 to find out the efficacy of selected bio-formulations viz. Bioveer, Biozium, Biomonas, Biogreen-5 and Copper oxychloride. Treatments were sprayed and per cent disease incidence was recorded at an interval of 15 days. None of the bio formulations was found superior than copper oxychloride, where lowest disease intensity (6.90%) was recorded. Among bio-formulations, Biogreen-5 (6.93%) found to be best, followed by Biomonas (13.13%), Biozium (14.96%) and Bioveer (15.41%) in contrast to control beds (17.73%). Bio-formulations promoted the growth of plants in terms of leaf area, shoot length, root length, root dry and fresh weight, thus showed dual roles as bio control agents and plant growth promoters. Biochemical analysis revealed the highest total chlorophyll and flavonoid content in plants treated with Biogreen-5 whereas, MDA (Malondialdehyde content) in leaf tissues was found to be highest in control and lowest in beds treated with Biogreen-5 and copper oxy chloride.

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**Department: Plant Pathology, BNCA**

**Major Adviser: Dr. K. Sarmah**

## **Efficacy of Green Synthesized Zinc Oxide Nanoparticles (ZnO NPs) against Different *Fusarium* spp.**

*Rashmita Saikia*

Nanotechnology in agriculture is an emerging or evolving technology. Biosynthesis of nanoparticles has received much attention as compared to physical or chemical synthesis due to its eco-friendly nature, low toxicity, production of stable nanoparticles and ease of preparation. In this study, in vitro efficacy of green synthesized Zinc oxide nanoparticles (ZnO NPs) and their mode of action against fungal wilt pathogens viz., *Fusarium oxysporum* f.sp. lentis (Fole), *Fusarium oxysporum* f.sp. cubense (Foc) and *Fusarium oxysporum* f.sp. lycopersici (Fol) were studied. Biological synthesis of ZnO NPs was carried out from different plant and microbial sources and their characterization was done through UV-Vis spectroscopy, Zetasizer, FTIR and TEM analysis. Scanning electron microscopy (SEM) was used to study the mode of action of the most effective biosynthesized ZnO NPs through the changes in morphology of fungal hyphae treated with ZnO NPs. Results of the in vitro efficacy of green synthesized ZnO NPs from the three plant sources and two microbial sources showed that only two biological sources viz., Piper nigrum and *Trichoderma harzianum* expressed highest inhibition against the three *Fusarium* spp. at a concentration of 1000 ppm. 72.20 %, 55.55 % and 51. 11 % of mycelial growth inhibition was recorded by ZnO NPs synthesized from *Trichoderma harzianum* and 68.88 %, 54.44%, 44.44% inhibition by ZnO NPs synthesized from Piper nigrum against Foc, Fole and Fol,, respectively. Further, green synthesized ZnO NPs from these two best sources were tested against the considered pathogens at three different concentrations (100ppm, 150 ppm and 200 ppm). Among these three concentrations, 200 ppm showed comparatively more inhibition against all the three tested pathogens. Furthermore, the treatment with 200 ppm concentration showed highest inhibition against Foc synthesized from both the selected biological sources viz., Piper nigrum and *Trichoderma harzianum* where percent inhibition of 58.80% and 61.10% was recorded , respectively. Thus, at 200 ppm concentration, ZnO NPs synthesized from *Trichoderma harzianum* was found to be more effective against Foc as compared to ZnO NPs synthesized from Piper nigrum.

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SEM and light microscopy images revealed various hyphal deformations on treatment with ZnO NPs such as coiling, shrinkage, swelling, clumping which eventually led to the death of fungal hyphae. These results suggest that ZnO NPs could be used as an effective fungicide in agricultural and food safety applications.



## **Siderophores of fluorescent Pseudomonads and their role in suppression of bacterial wilt (*Ralstonia solanacearum*) of chilli**

*Sukanya Gogoi*

Isolates of fluorescent Pseudomonads are effective bacterial antagonist against *Ralstonia solanacearum* causing bacterial wilt. Under iron stress condition isolates of fluorescent Pseudomonads also secrete a secondary metabolite compound known as siderophore which acts as specific iron chelating agent. The present study aimed to identify siderophore producing isolates of fluorescent Pseudomonads isolated from rhizospheric soil of Chilli from five districts of Assam viz., Golaghat, Jorhat, Sivsagar, Dibrugarh and Tinsukia district and to characterize, its production and purification of Siderophores and antagonistic action against bacterial wilt caused by *Ralstonia solanacearum* of chilli. Eleven different isolates of fluorescent Pseudomonads from five districts were used for the production of siderophore at optimum temperature of 30 degree C, 72 hour of incubation period in shake condition (90 rpm) and pH7 in an iron free succinate media. All the 11 isolates showed positive result for siderophore production. The maximum percentage of siderophore unit is produced by the isolates PfA2 (85.07%) and PfS2 (82.61%) when screened for siderophore production on a Chrome azurol S liquid assay method. By Csaky Assay the formation of pink colour by all the 11 fluorescent Pseudomonad isolates indicated the Hydroxamate-type of siderophore and also showed additional features like production of hydrogen cyanide, Ammonia Production, Phosphate solubilization and antagonistic action against *Ralstonia solanacearum*. Two best effective siderophore producing isolates of fluorescent Pseudomonads showing highest inhibition (%) against *Ralstonia solanacearum* viz., PfA2 & PfS2 (6.81 cm & 6.10 cm, respectively) selected for the management of Bacterial wilt of chilli caused by *Ralstonia solanacearum*. The percent wilt incident (PWI) of chilli decreased significantly in plants treated with siderophore producing fluorescent Pseudomonads. The lowest record PWI (1.00%) was recorded in treatment combination with both the isolates PfA2 and PfS2, viz., Seed treatment + Soil treatment + Seedling root dip treatment. Correlation studies revealed that wilt incidence was positively correlated with population dynamics of *R. solanacearum* in the chilli crop rhizosphere and was negatively correlated with population dynamics of the isolates of fluorescent Pseudomonads in rhizospheric soil and yield of chilli.

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## **Eco-friendly management of late blight, red ant and aphid in Potato**

*Swgwmsar Basumatary*

Potato (*Solanum tuberosum* L.) crop produces more food and edible protein per unit area and time as compared to any other major food crop for which the crop has been known presently as “Food for the future”. It contains starch, sugar, cellulose, crude fibre, pectic substances, protein, amino acids, lipids, vitamin c, enzymes, minerals (P, Ca, Mg, K, Fe, S, Cl). Among the various diseases of potato, late blight caused by *Phytophthora infestans* (Mont.) de Bary, and leaf roll of potato caused by potato leaf roll virus are most important. Among the soil pest of infestation of potato tuber by red ant (*Dorylus orientalis*) is common in Assam. In the present investigation efficacy of two different form of copper fungicides viz. copper oxychloride and copper hydroxide were evaluated against late blight of potato caused by *Phytophthora infestans* (Mont.) de Bary under two different spray schedules (10 sprays at 4 days interval and 8 sprays at 5 days interval) Both the fungicide were found effective in delaying appearance of late blight and also in reducing intensity of the disease to a varying extent. Application of 10 sprays of copper hydroxide @ 0.2% at 4 days interval could provide highest protection of (50.00%) to the late blight susceptible potato variety Kufri Ashoka with a maximum tuber yield of 11.75 t/ha. However, maximum net return Rs. 43,408 with a corresponding incremental benefit-cost ratio of 1.63 was recorded in the treatment consisting 8 numbers spray @0.2% at 5 days interval. Four bio-formulations (Biometa, Biosona, Biollium and Biogreen) developed by AAU were tested for their comparative efficacy against red ant on potato. The combined tuber treatment with Biosona (*Beauveria bassiana*) @ 6 gram per kg seed and soil application in the form of enriched compost (1:10) @ 2 tonnes per hectare is effective in reducing red ant infestation and increasing marketable tuber yield. This treatment combinations recorded an incremental B:C ratio of 2.14. Among the four bio-formulations Biolium (*Verticillium lecanii*) showed highest efficacy in reducing population build up of aphids in incidence of potato leaf roll virus when applied @ 0.5% spray at 40, 50 and 60 days after planting.

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**Department: Plant Pathology**

**Major Adviser: Dr. M. K. Saikia**

# **Exploring the Effect of *Allamanda* Extract for yield Enhancement and Suppression of *Trichoderma* Contamination in Oyster Mushroom Beds**

*Tanushree Das*

Mushrooms have been considered a part of delicious cuisine all over the world, owing to their distinct flavour, high nutrient value, and appreciation by humankind as a culinary marvel. With the increasing need of stable, sustainable and eco-safe food production and diet conscious individuals in the world, the popularity of mushroom has increased considerably over the last three decades. But along with the increasing popularity of this sector, there is an increasing necessity of continuous betterment of the production technologies so as to reduce the disease incidences and increase yield. The present study sought to investigate the use of *Allamanda cathartica* leaf extract on yield enhancement and *Trichoderma* suppression of oyster mushroom (*Pleurotus ostreatus*). Among four different concentrations (5, 10, 15 and 20%), *Allamanda* extract at 20% significantly enhanced mycelial growth (44.92%) over control followed by *Allamanda* extract at 15 % (25.57%). Based on the in vitro test, *Allamanda* extract at 15 and 20% were further tested for in vivo study in two different forms (crude and centrifuged extract) for 4 different storage periods (0, 7, 14 and 21 days). The days required for complete substrate colonization was significantly less (15.67) in beds treated with fresh centrifuged extract @ 20% as compared to the control (20.33). Lowest number of days (3.67) for pinhead formation was recorded in beds amended with fresh centrifuged extract @ 20%, @15% and 7 days old centrifuged extract @ 20% and highest (6.67) in control. Maximum cap size (6.36 cm) and number of fruiting bodies (125.00) were recorded in beds treated with 7 days old centrifuged extract @ 20 % with enhanced yield up to 87.91 per cent over control. However, highest per cent increase in yield (89.33%) was recorded in fresh centrifuged extract @ 20% treated beds. Among the storage periods, fresh and stored *Allamanda* extract for 7 days were found to be highly effective in reducing the disease incidence as compared to the 14 and 21 days old stored extracts.

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**Major Adviser: Dr. H. K. Deva Nath**

## **Influence of sowing dates on incidence and severity of viral disease complex on soybean under field conditions**

*TC Lalruatfeli*

Soybean, *Glycine max* (L.) Merrill belongs to the family Fabaceae. It has been established as the world's most important seed legume owing to its high contribution of 25% of the global edible oil. In this study, we aim at molecular detection of viruses causing mosaic disease in soybean field of ICR farm, AAU, Jorhat. Two viral diseases viz., Mungbean Yellow Mosaic Virus (MYMV) and Cowpea Mild Mottle Virus (CPMMV) were identified. MYMV, a Begomovirus was amplified with a primer targeting the coat protein region of the virus generating an amplicon size of 524bp and CPMMV, a Carlavirus was confirmed using primers of amplicon sizes 886bp and 216bp. Viral diseases affecting soybean causes significant crop losses economically. Young leaves initially experience it as yellow patches subsequently spreads to neighboring leaves the veins. A severe infection can result in the entire leaf turning yellow or chlorotic, which can affect the entire plant. The present study aims to know the significance of modifying sowing dates. The results have shown that the disease incidence ranges from 1.52% reaching upto 33.09% in which the earlier sown crops produces lesser symptoms compared to later sowing dates. Correlation analysis of the disease incidence with weather parameters have shown that maximum relative humidity, maximum temperature and sunshine hours have significant positive correlation while minimum relative humidity and minimum temperature were found to have negative significant correlation with the disease incidence. The results of the stepwise regression shows that the R<sup>2</sup> statistics for all the treatments range from 0.61 to 0.84 indicating the weather parameters affects around 61% to 84%.

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**Department: Plant Pathology**

**Major Adviser: Dr. Munmi Borah**

# **Study on effect of methionine and tryptophan on the larval growth, cocoon characters and reproductive parameters of eri silkworm, *Samia ricini* Donovan**

*Abhyarthana Hazarika*

A study on effect of methionine and tryptophan on the larval growth, cocoon characters and reproductive parameters of eri silkworm, *Samia ricini* Donovan was carried out during the month of December-February, 2020-2021 in the Department of Sericulture, Assam Agricultural University, Jorhat. The study revealed that fortification of castor leaves with methionine and tryptophan significantly improved the larval growth, cocoon characters as well as reproductive parameters of eri silkworm, *Samia ricini* Donovan. Methionine and tryptophan supplementation especially at 500 ppm concentration found to have more pronounced effect as compared to the remaining concentrations over the control. Fortification of castor leaves with tryptophan at the rate of 500 ppm concentration resulted in maximum increment in respect of larval and cocoon parameters viz., larval weight (both full grown and matured), silk gland weight, Silk Gland Tissue Somatic Index (SGTSSI), cocoon yield (g/100 nos. of larvae), cocoon weight, pupal weight, shell weight and shell ratio. Reproductive parameters including total moth emergence, male and female adult longevity, fecundity and hatching percentage also showed a notable influence in larvae fed on 500 ppm tryptophan fortified castor leaves. In case of developmental periods viz., larval (fourth and fifth instar) as well as pupal periods, a significant decrease was observed in amino acid treated batches over control and was more prominent at 500 ppm tryptophan. However, 500 ppm methionine followed by 500 ppm tryptophan reduced the incubation period. The combination treatments of methionine and tryptophan did not express much improvement in respect of these parameters when compared to the individual treatments of methionine and tryptophan. It was observed that fortification of castor leaves with methionine and tryptophan did not have any significant effect on third instar larval duration, Effective Rate of Rearing (ERR), individual male and female moth emergence as well as coupling percentage of eri silkworm. Thus, from the present investigation it can be inferred that fortification of castor leaves with methionine and tryptophan is

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effective for improvement of larval growth, cocoon characters and reproductive parameters of eri silkworm. Though all the concentrations had positive impact on all the parameters but tryptophan and methionine at a concentration of 500 ppm was more efficient and exert promontory effect than other doses for improving larval growth, cocoon characters and reproductive parameters.

## **A study on the extent of adoption of scientific muga culture technology by the rearers of Sonitpur district of Assam**

*Dababrata Saikia*

The present study entitled “A study on the extent of adoption of scientific muga culture technology by the rearers of Sonitpur district of Assam” was conducted in Sonitpur district of Assam during the year 2020-2021. To attain the objective of the study a purposive and random sampling design was followed for selection of the respondents and a total of 120 respondents were selected. Appropriate statistical tools viz., frequency, percentage, mean, standard deviation, correlation and chi-square test were applied to analyse the data. The study revealed that majority of the respondents (42.50%) belonged to the middle age group. Most of the respondents (47.50%) belonged to the category OBC (Other Backward Class) and had their (35.00%) education up to middle school. Among the respondents, medium size (50.00%) family was found to be dominant and farming was their primary occupation with medium level of income ranging from Rs. 52,000- 1,71,000. Regarding size of operational land holding, majority (40.83%) of the muga farmers owned operational land holding of 1-2 ha. Majority of the respondents (48.33%) had farming experience between 10-20 years. It was also observed that most of the respondents (73.33%) had medium level of extension contact, medium risk bearing ability (65.83%), medium decision making ability (60.83%) and medium level of marketing orientation (69.17%). As regards to training exposure, only 27.50 per cent of the respondents had received any training. The study further revealed that 65.83 per cent muga farmers exhibited medium level of extent of adoption. Operational land holding, primary occupation of the family, annual family income, farming experience, risk bearing ability, decision making ability, marketing orientation and training exposure were found to be positive and significantly associated with the extent of adoption. Major problems faced by the muga rearers are lack of self-awareness or interest on adoption of technology, lack of glamour, lack of own land, adverse climatic condition, non-availability of storage facilities for cocoons, lack of adequate knowledge regarding cultivation practices of host plants and rearing practices of muga, nonavailability of regulated cocoon market, non-availability of own vehicle and delay in

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getting loan. Adoption of scientific technologies among the farmers has significant impact on growth and development of muga silk industry as well as economic benefit of the farmer. Effective extension intervention may aid the process of intensification for full scale commercialization of muga silk production by facilitating adoption of scientific package of practices. Suitable and need based training should be organised by the concerned authority for improving knowledge and skills regarding scientific muga rearing and cultivation practices in the study area.



## **Study on defoliators and their natural enemies in mulberry ecosystem**

*Deeplina Bora*

A study on defoliators and their natural enemies in mulberry ecosystem were carried out during the year 2019-2021 at Regional Sericulture Research Station, Central Silk Board, Jamuguri, Jorhat. The study revealed that five species of defoliators were prevalent in mulberry growing field at Regional Sericulture Research Station, CSB, Jamuguri, Jorhat. Mulberry pyralid (*Glyphodes pyloalis* Walker) (Lepidoptera: Pyralidae) was dominant among the five species of defoliators, viz., tussock caterpillar (*Euproctis fraterna* Moore) (Lepidoptera: Lymantriidae), mulberry leaf roller (*Glyphodes pyloalis* Walker), bihar hairy caterpillar (*Spilosoma oblique* Walker) (Lepidoptera: Arctiidae), tobacco cutworm (*Spodoptera litura* Fabricius) (Lepidoptera: Noctuidae), wingless grasshopper (*Neorthacris acuticeps nilgriensis* Uvarov) (Orthoptera: Acrididae). Four species of Hymenopteran parasitoid viz., *Bracon hebetor* Say (Hymenoptera: Braconidae), *Apanteles* sp. (Hymenoptera: Braconidae), *Cotesia* spp. (Hymenoptera: Braconidae), *Chelonus* spp. (Hymenoptera: Braconidae) and one species of coleopteran predator viz., *Carabid* beetle (Coleoptera: Carabidae) were found to associated with *Glyphodes pyloalis*. Among these natural enemies, *Bracon hebetor* was relatively most abundant. The appearance and peak activity of the braconid parasitoids *Bracon hebetor*, *Apanteles* sp., *Chelonus* sp., *Cotesia* sp. and one coleopteran predator *Carabid* beetle was synchronized with that of *Glyphodes pyloalis*. These four parasitoids showed a strong significant positive association with the mulberry pyralid population.

The biology of tobacco caterpillar (*Spodoptera litura* Fabricius) on mulberry leaves was carried out during the study at Department of Entomology, Assam Agricultural University, Jorhat. The developmental parameter viz., incubation period (days), hatching percentage (%), total larval period (days), pre-pupal period (days), pupal period (days), adult emergence (%), sex ratio (female: male) were 3.06 days, 87%, 14.60 days, 1.60 days, 7.20 days, 42.59%, 1:0.6 respectively. Reproductive parameters including pre oviposition period (days), oviposition period (days), total fecundity (no. of egg/female), rate of oviposition (no of egg/day/female), post oviposition period (days),

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adult longevity male (days) and female were 3.75 days, 4 days, 1066.13 eggs/female, 216 no of eggs/day/female, 2.5 days, 6.73 days, 7.73 days, respectively.

The biology of braconid parasitoid, *Bracon hebetor* revealed adult emergence (%), sex ratio (male: female), adult longevity male (days), adult longevity female (days) were 34.60%, 1.6:1, 8.57 days, 10.41 days, respectively.

## **Tapioca (*Manihot esculanta*) cultivation as an alternate farm plan for rearing eri silkworm in Udalguri district of Assam**

*Jugabrat Sarma*

The present study was carried out in Udalguri district of Assam with a sample of 120 respondents by following purposive cum random sampling technique to attain the objectives of the study. Appropriate statistical tools viz., frequency, percentage, mean, standard deviation, weighted mean score and multiple regression analysis were employed to analyze the data. The findings revealed that majority (50.83%) of the respondents were in the age group of 36- 56 years with middle school level of education (35.83%) and belonged to small sized family consisting of 2-4 members (56.67%). Majority (64.17%) of the sericulture farmers in Udalguri district had pucca houses who considered sericulture as their primary source of income (56.67%). Most of them (75.83%) had an average annual income between Rs. 65,000 to Rs. 1,40,000; most of the respondents (60.83%) had up to 2 working members in their household and were marginal farmers with land holding below 1 ha (55%). Moreover, majority (75.83%) of the respondents were having medium level of farming experience between 10-20 years, medium level of extension contact (55%) and had medium level of source for collecting information (55.83%). Majority of the respondents (71.67%) had membership in farmers' organization. The factors affecting likelihood of adoption were analyzed through multiple regression. Through the analysis, it was found that primary source of income, size of operational land holding, farming experience, extension contact and knowledge level were the significant factors that influenced the extent of likelihood of adoption of scientific tapioca cultivation practices. The major problem faced by the rearers were lack of formal education, lack of glamour, lack of own land, lack of rearing area, lack of knowledge on protection measures and management, lack of own capital, fluctuation in products price, high cost of hiring vehicle and lack of need-based training. The findings suggested that the government should take proper initiatives to help the eri rearers and proper financial, technical and other supports should be provided to the rearers by the extension agencies, institutions etc. Periodical need-based training should be provided and timely meetings should be made between the rearers and experts to get

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proper information and solutions. It is imperative to conclude from the study that eri industry is strong enough to establish a distinctive identity in the study area. Tapioca cultivation involves simple scientific technology which is easy to understand and adopt. The rearers need to be encouraged towards the adoption of scientific recommended practices of tapioca to achieve better production and income generation. Thus, the rearers of Udalguri should be made realized about the economic importance of tapioca and encourage them to consider it as an alternate farm-based plan for rearing of eri silkworm.

## **Studies on incidence and population build up of Amphutukoni muga (*Cricula trifenestrata* Helfer) on Som (*Persea bombycina* King.) plant**

*Parashpriya Borah*

Studies on incidence and population build up of Amphutukoni muga (*Cricula trifenestrata* Helfer) on Som (*Persea bombycina* King.) plant was carried out in Jorhat and neighbouring areas of Jorhat district for the period of March, 2020 to March, 2021. The objective of the investigation was to study the nature of damage, incidence and population build up of *Cricula trifenestrata* on som plant and its relationship with the meteorological factors. The nature of damage of the pest was observed on 10 randomly selected som plants at 15 days interval and plant parts damaged by the insect, type of feeding, defoliation of leaves etc. were recorded carefully. For estimating population build up, the pest was recorded by counting the number of insects present on four branches per plant from 10 randomly selected plants. Four infested branches from each plant from each direction were selected and the number of insect (*Cricula trifenestrata* Helfer) present in each branch were counted. For of the incidence of the pest, the mean rate of infestation and extent of damage were recorded. It was observed that the larvae of *Cricula trifenestrata* caused damage to Som plant by devouring the leaves and by causing defoliation of the entire plant. The pest population was maximum in January ( $32.97 \pm 1.91$  No. of insect per branch) and lowest in July ( $8.75 \pm 0.35$  No. of insect per branch). Mean rate of infestation was maximum in January ( $85.00 \pm 7.07\%$ ) and lowest in July ( $20.00 \pm 0.00\%$ ). Extent of damage was recorded highest in January ( $68.36 \pm 2.42$  No. of insect per plant) and lowest in July ( $15.25 \pm 2.47$  No. of insect per plant). The no. of cocoon formation and no. of cluster formation was highest in the month of January, 2021. The present investigation revealed that, the Amphutukoni muga, *Cricula trifenestrata* is one of the serious pest of Som. Severity of damage by the pest during the peak period of its activity become the major threat to the sericulture industry because it causes economic damage to the muga crop. Scope of further research work is to use effective eco-friendly methods to manage the pest anticipates in this field of study.

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# **Studies on Epidemiology and Management of Cercospora Leaf Spot of Castor (*Ricinus communis* L.) in Agro-climatic Condition of Assam**

*Prety Rekha Narzary*

Castor (*Ricinus communis* L.) is the primary host plant of the eri silkworm *Samia ricini* Donovan, a domesticated polyphagous multivoltine lepidopteran insect which is responsible for producing the eri silk. The healthy and robust growth of the eri silkworms primarily depends upon the quality and quantity of castor leaves, which ultimately reflects in the qualitative and quantitative parameters of the cocoons produced. Cercospora leaf spot of castor, caused by *Cercospora ricinella* Sacc. & Berl. is one of the major foliar diseases encountered in the cultivation of castor, causing substantial injury to leaves intended as feed for eri silkworms. Study on occurrence and epidemiology was done during three seasons i.e. pre-monsoon (Mar-May), monsoon (Jun- Aug) and post-monsoon (Sept-Nov) by correlating weather parameters such as, temperature, rainfall, number of rainy days, relative humidity and bright sunshine hours with disease incidence. It was inferred that, disease incidence was prevalent at high levels during the pre-monsoon season (Mar-May) followed by monsoon as compared to post-monsoon season. Disease incidence is positively correlated to maximum temperature (significant), minimum temperature, RH (at P.M.), rainfall and number of rainy days (non-significant) and negatively correlated to RH (at A.M.) and BSSH (nonsignificant). A total of 8 treatments were taken for the experiment of management of the disease in pot condition. The treatments included a phytoextract of Tulsi (*Ocimum sanctum*) @ 5%, a bio agent (*Trichoderma viride*) @ 5% and a chemical fungicide (Copper oxychloride) @ 0.2 % and their combinations, applied as foliar spray at 15 days interval. None of the eco-friendly treatments were found superior than chemical fungicide inclusive treatment, Tulsi extract + *T. viride* + Copper oxychloride, where lowest disease incidence was recorded (7.13%). Among eco-friendly treatments, Tulsi extract + *T. viride* (12.48 %) was found to be the best. Treatments containing *T. viride* promoted the growth of plants in terms of leaf area, shoot length, root length, dry and fresh weight of root, thus showing dual roles as bio control agent and plant growth

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promoter. Biochemical analysis revealed the highest total chlorophyll and flavonoid content in plants treated with Tulsi extract + *T. viride* + Copper oxychloride whereas, MDA (Malondialdehyde content) in leaf tissues was found to be highest in control and lowest in pots treated with Tulsi extract + *T. viride* + Copper oxychloride. Another investigation was conducted to find out the effect of treated castor leaves on eri silkworm growth. Silkworms fed with castor leaves treated with *T. viride* + Tulsi extract showed the best results followed by worms fed with leaves treated with Tulsi extract + *T. viride* + COC.

# **Studies on the production, processing and marketing of sericulture in Dima Hasao district of Assam**

*Rastra Nunisa*

Sericulture has been practiced in Assam for a long period of time, and the State is proud of traditionally producing Eri, Muga and Mulberry silks. Dima Hasao is one of the important districts of Assam where all four types of silk are available viz. Eri, Muga, Mulberry and Oak Tasar, the prime position occupied by ericulture. The other three silks has lost its competitiveness in recent times but has a scope because of its varying climatic conditions amongst the seri-zone of the district. The study was conducted to analyze “Production, Processing and Marketing of Sericulture in Dima Hasao”, having five development blocks and selecting randomly two villages each from the blocks. A total of 100 respondents were selected randomly for the study. Primary and secondary data collected were edited, scored, systematically tabulated and analyzed by using various statistical tools and techniques such as percentages, compound growth rates, marketing cost and margin analysis, price spread and marketing efficiency, Garrett ranking etc. The study reveals that Dima Hasao is ericulture dominated with an average of 94.03 % families engaged contributing an average production of 3.7 % cocoon and 3.8 % raw silk respectively to the total production of the State. Though negative(-ve) growth rate (-23.72) was observed in Muga, there was significant increase in Eri(15.80) and Mulberry(15.03). Similar trend was also observed in raw silk production in the district. Traditional method of processing of sericulture in the district was still followed by the respondents using Takli and spinning charkhas for yarn production. The main fabric made by eri yarn was a special type of shawl called Rhithap, suitable in winter. Two marketing channels were identified for cocoon marketing and one channel for pupae marketing. Majority (92.37 %) of cocoons were observed to be transacted through channel-I (Rearer - Broker – Consumer). Cocoon price keeps fluctuating, sold for Rs. 600-700 per kg and Rs.500 per kg for pupae. Marketing efficiency was found to be higher in the channel-II in case of cocoon marketing. Shortage of feeds, lack of healthy seeds, lack of information etc were some main constraints encountered during cocoon production. Unavailability of equipments, financial problems, unavailability of proper

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market structure etc were also identified to be main problems in processing sector. Price fluctuation, middlemen interference, marketing problem etc were also associated in sericulture market channels.

## **A Study on the Training Need Assessment of Silkworm Rearers in Golaghat District of Assam**

*Sewali Gogoi*

The present study was conducted in 8 selected villages from the Golaghat district of Assam with 160 randomly selected silkworm rearers to assess the training needs towards scientific silkworm rearing practices. The data were collected personally through the scheduled interview and the tool of data collection was research schedule. The collected data were analyzed by using suitable statistical tools viz., frequency, percentage, mean, standard deviation and correlation. The results of this study revealed that majority (60.63%) of the respondents were middle aged (36-50 years), 41.25% had passed middle school, 55.00% had small sized family, 50.00% were belonged to OBC category, 40.62% had semi pucca house, 60.62% were marginal farmer with land holding below 1 ha, 61.88% of the respondent's primary occupation was exclusively farming, 73.12% had medium level of income ranging from Rs. 45,630.07 to 1,24,682.43, 63.75% had farming experiences between 5.27 to 19.53 years, 73.13% of the respondents had medium level of extension contact, 75.00% of the respondents had medium level of mass media exposure, majority (60.62%) of the respondents were not affiliated with any organizations, only 25.63% of the respondents had attended training on different areas of silkworm rearing practices, 59.38% used the marketing channel "producer- consumer" followed by the "channel producer-village-trader-consumer" (28.12%). It was also found that farming experience, extension contact and social participation were positively and significantly associated and age was negatively and significantly associated with the extent of training needs of the silkworm rearers. The major problems faced by the silkworm rearers were lack of selfawareness, lack of glamour, lack of own land, lack of awareness to manage harsh environmental conditions, incidence of disease/pest in silkworms, lack of storage facilities, lack of regulated marketing support, non-availability of own vehicle and, delay in getting loan. The findings revealed that majority of the rearers exhibited medium level of training need in eri, muga and mulberry silkworm. Majority of silkworm rearers desired training at village level once in a year for a period of one week at pre crop season in the afternoon time and also practical utility training with amenities like stipend, transportation, free boarding and teaching through demonstration using local language.

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Therefore, offering timely, appropriate, and need-based training might be very beneficial for enhancing their knowledge and expertise in terms of scientific silkworm rearing practices.

# **Influence of fertilizer management practices on point of zero charge (PZC) in soils of Assam and Odisha**

*Subhra Parija*

An incubation study was undertaken to examine the influence of fertilizer management practices on the point of zero charge (PZC) in soils of Assam and Odisha. Six number of geo-referenced surface soil samples (0-15 cm) viz., black soil (Vertisol), laterite soil (Alfisol), red soil (Alfisol) and three alluvial soil samples belonging to Entisol, Inceptisol and Alfisol were collected from Kalahandi, Khordha and Dhenkanal districts of Odisha and Dergaon, Golaghat, ICR Farm AAU, Jorhat and Titabor, Jorhat of Assam, respectively. The soils strikingly varied in their mechanical composition, bulk density and moisture content at field capacity. The soils were mostly acidic in nature (pH 5.04 – 5.71) except black soil of Odisha which was slightly alkaline (pH 7.93). Organic carbon in Odisha soils ranged from 0.21 - 0.95% and lied between 0.47 - 0.86% in soils of Assam. All the soils were low to medium in available NPK but exhibited high content of available S. Laboratory incubation of these soils (200g) were carried out after treatment with four different fertilizer management practices viz., FYM @ 5 t ha<sup>-1</sup> (T1), NPK @ 80:40:40 for Odisha soils and 60:20:40 for Assam soils (T2), FYM @ 5 t ha<sup>-1</sup> + NPK @ 80:40:40 for Odisha soils and 60:20:40 for Assam soils (T3) and FYM @ 5 t ha<sup>-1</sup> + NPK @ 80:40:40 for Odisha soils and 60:20:40 for Assam soils + Lime requirement/ Gypsum requirement (T4), in three replications. Sub samples were drawn after an interval of 15 and 30 days after treatment (DAT) and analysed. The PZSE and PZNC of the incubated samples were estimated through potentiometric titration and ion retention methods, respectively. Pearson's correlation coefficient between PZC components and relevant soil properties was studied. The effect of the applied treatments on the PZC components and nutrient availability was evaluated using ANOVA for CRD. Results revealed that the PZSE for Odisha soils ranged from 2.18 to 4.70 and lied between 3.60 and 4.16 for the soils of Assam. The PZNC was achieved at comparatively lower pH values, ranging from 2.03 to 4.10 for Odisha soils and from 2.50 to 3.61 for Assam soils. The order of PZC for the samples was in direct correlation with their respective sesquioxide contents. Factors like clay, organic carbon,

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exchangeable calcium and available phosphorus imposed a significant influence on soil PZC values. The treatment T2 resulted in highest availability of the primary nutrients for all the soils under incubation while maximum availability of secondary nutrients was recorded under treatment T4. Availability of all the nutrients decreased at 30 DAT as compared to that of 15 DAT, except for Ca and Mg where the availability was more at 30 DAT. The treatment effect was insignificant on the sesquioxides content of incubated soils. Highest values of PZSE and PZNC were recorded under treatment T2 followed by T3, T4 and T1 for all the incubated soil samples of Odisha and Assam, however there was a decrease in the PZC values with increase in days of incubation. Such results confer that these soils allow more availability of anionic nutrients such as nitrate ( $\text{NO}_3^-$ ), phosphate ( $\text{PO}_4^{3-}$ ), sulphate ( $\text{SO}_4^{2-}$ ) immediately after fertilizer application, which slowly decreases with time favoring an increased CEC in the latter phase and thereafter enhancing the availability of cationic nutrients such as ammonium ( $\text{NH}_4^+$ ), potassium ( $\text{K}^+$ ), calcium ( $\text{Ca}^{2+}$ ), etc. In comparison to other treatments, the treatment T4 consisting of organic manures, recommended dose of chemical fertilizers along with lime/gypsum resulted as the most ideal fertilizer management practice. Besides providing optimum amount of primary nutrients and maximum amount of secondary nutrients, it regulated the PZC values favouring minimal loss of nutrients leading to enhanced crop production.

# **Assessment of sediment yield and water quality of Bhogdoi river basin using remote sensing and GIS techniques**

*Abinash Mazumder*

An investigation was carried out to assess the sediment yield and water quality of Bhogdoi river basin using remote sensing and GIS techniques. Based on satellite data, three distinct topographic units were identified in the study area which included: Upstream, Middle stream and Downstream covering an area of 46.72 sq. km, 76.40 sq. km. and 21.09 sq. km, respectively. GPS based surface soil samples were collected from the study area which were analyzed for various physico-chemical and erosion related properties. Water samples of Bhogdoi river both in pre monsoon and post monsoon season, as well as sediments and groundwater samples were also collected for analyzing various quality parameters. Various thematic maps pertaining to important hydrophysical properties along with soil and nutrient erosion were prepared under ARC GIS environment. The studied soil samples showed wide variations in texture varying from sandy loam to silty clay loam, while massive and sub angular blocky structure were found to be dominant in the area. The bulk density of the soils ranged from 1.20 Mg/m<sup>3</sup> to 1.68 Mg/m<sup>3</sup> and the particle density exhibited a range from 2.08 Mg/m<sup>3</sup> to 2.59 Mg/m<sup>3</sup>. The porosity of the soils was observed in a range from 30.00% to 48.70%. The hydraulic conductivity of the soils in the studied basin varied from 0.85 cm/hr to 8.32 cm/hr. The water holding capacity of the soils ranged from 14.41% to 53.55%. The value of field capacity, permanent wilting point and available water content of soils in the studied area varied from 11.41% to 30.32%, 3.23% to 15.55% and 5.92% to 19.61%, respectively. Hydraulic properties like porosity, water holding capacity, field capacity, permanent wilting point and available water content was found to be higher in the lower elevation area. The pH and electrical conductivity of the analyzed soil samples ranged from 4.16 to 5.39 and from 0.011 ds/m to 0.066 ds/m, respectively. The organic matter content of the studied soils varied from 6.21 g/kg to 17.58 g/kg. The total nitrogen content of the experimental site was found to be low to medium which varied from 0.085% to 0.228%. Total phosphorus content of the soils were low ranging from 0.012% to 0.043%. Total potassium content of the studied area was found to be varying from

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**Abstract of M.Sc. thesis**

**Department: Soil Science**

**Major Adviser: Dr. Bipul Deka**

0.472% to as 2.157%. The available nitrogen, phosphorus and potassium in the analyzed soil samples varied from 75.62 kg/ha to 413.95 kg/ha, from 14.50 kg/ha to 52.41 kg/ha and from 45.05 kg/ha to 279.24 kg/ha, respectively. Organic matter, total nitrogen and available nitrogen were found to be maximum in the downslope. 6 The macro-aggregate of soils of the studied area varied from 40.45% to 69.75%, while the micro-aggregate ranged from 30.24% to 59.54%. The mean weight diameter of soils of the studied area ranged from 1.36 mm to 2.48 mm. The dispersion ratio, erosion ratio and erosion index of soils of the experimental site was found to be within the range of 0.08 to 0.55, 0.02 to 0.33 and 0.05 to 0.37, respectively. The erodibility indices were found to be highest in upper elevation area. The annual soil loss, sediment yield and nutrient erosion were found to be maximum in upstream followed by middle stream and downstream. It was observed that 39.68% area of the Bhogdoi river basin was severely eroded, while 2.64% area was very severely eroded. The sediments of Bhogdoi river were found to be coarser and sandy loam was the dominant texture. The pH of the collected sediments was found in a wide range from strongly acidic to slightly alkaline (4.81 to 7.70), while the electrical conductivity of the sediments was found to be low which ranged from 0.012 to 0.047 ds/m. The organic matter content (mean value 0.38 g/kg) and total nitrogen (mean value 0.038%) of the sediments of the Bhogdoi river were also found to be low. The total phosphorus and total potassium of the sediment samples exhibited a range from 0.007% to 0.017% and from 0.051% to 1.375%, respectively. Surface water parameters like pH, electrical conductivity, total dissolved solid, chloride, carbonate, bicarbonate, calcium, magnesium, total hardness, residual sodium carbonate, arsenic and fluoride were found more in pre monsoon period having mean values of 7.05, 0.142 ds/m, 168.54 mg/l, 93.81 mg/l, 19.84 mg/l, 135.18 mg/l, 36.68 mg/l, 5.42 mg/l, 42.10 mg/l, 0.60 me/l, 0.033 mg/l and 0.740 mg/l respectively than that of post monsoon season with average values of 6.90, 0.140 ds/m, 167.76 mg/l, 92.71 mg/l, 9.23 mg/l, 106.08 mg/l, 27.74 mg/l, 4.86 mg/l, 32.60 mg/l, 0.27 me/l, 0.029 mg/l and 0.711 mg/l respectively. On the contrary, quality parameters like dissolved oxygen, chemical oxygen demand, total suspended solid and turbidity were observed more in post monsoon season with mean values of 7.33 mg/l, 12.80 mg/l, 20.07 mg/l and 11.86 NTU respectively than pre monsoon season having average values of 6.23 mg/l, 10.09 mg/l, 15.50 mg/l and 6.91 NTU respectively. All the groundwater parameters like pH, electrical conductivity, dissolved oxygen, chemical oxygen demand, total dissolved solid, total suspended solid, turbidity, chloride, carbonate, bicarbonate, calcium, magnesium, total hardness, residual sodium carbonate and fluoride were found to be under permissible range of FAO irrigation 7 water guidelines with mean values of 7.13, 0.160 ds/m, 2.11 mg/l, 30.10 mg/l, 268.17 mg/l, 25.02 mg/l, 10.14 NTU, 75.63 mg/l, 8.00 mg/l, 186.11 mg/l, 53.11 mg/l, 3.24 mg/l, 56.35 mg/l, 0.40 me/l and 0.972 mg/l, respectively except two samples of arsenic. Water quality index of Bhogdoi river was found to be low in the upstream which increased towards downstream. It was more in pre monsoon season (mean value 25.80) than in the post monsoon season (mean value 21.10). The water quality index of groundwater was found to be slightly higher (mean

value 32.46) than the surface water in the study area. Based on the water quality index value, both the surface water and groundwater of the study could be categorized under Class I with no restriction for using in irrigation purpose.



# **Assessment of Soil Zinc Fractions and their Relationship with Physico-Chemical Properties of Rice Growing Soils of Boko Block of Kamrup (rural) District, Assam**

*Abreeta Kalita*

A study on ‘Assessment of Soil Zinc Fractions and their Relationship with Physico-Chemical Properties of Rice Growing Soils of Boko Block of Kamrup(rural) District, Assam’ was conducted during 2019-2021 with the objectives to assess different zinc fractions along with the physical and chemical properties of three rice growing soils namely Ahu, Sali and Boro rice. The texture of the soils varied from sandy loam to clay loam for Ahu and Sali rice while clay loam in Boro rice growing soils with strongly acidic to moderately acidic in their reactions (pH 4.52 to 5.85). Soil organic carbon was medium to high in Ahu and Sali rice but high in Boro rice growing soils. All the available primary nutrients were medium in their status except available phosphorus which was low to medium. Significant negative correlations were recorded among soil pH, EC and SOC, and among sand, silt and clay fractions while significant positive correlation was observed between SOC with CEC, available nitrogen, clay and CEC with available nitrogen, potassium, exchangeable calcium, magnesium and clay and available nitrogen with clay and exchangeable calcium with exchangeable magnesium. The distribution of Zn-fractions followed a general order of dominance as WSEX-Zn<CRYOX-Zn<COMP-Zn<AMOX-Zn<RES-Zn and hence, appropriate soil-zinc management strategies need to be adopted in those soils.

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**Major Adviser: Dr. Kabindra Borkakati**

## **Nutrient Release Pattern of Organic Manures in An Acidic Inceptisol of Assam**

*Ankita Nath*

An incubation study was conducted to investigate the nutrient release pattern of organic manures in an acidic Inceptisol of Assam. The soil sample was collected from rice fields of Instructional cum Research farm of Assam Agricultural University, Jorhat. The soil was sandy clay loam in texture, strongly acidic in pH (5.5), high in organic carbon, medium in phosphorus and potassium, low in nitrogen and deficient in exchangeable Ca, Mg, DTPA-Mn, available S and hot water extractable B. The experiment was laid out in Completely Randomized Design with two factors viz., organic manure and days of incubation (DOI). Seven (7) organic manure treatments were viz., T0 (control) = Unamended, T1 (enrich) = Soil + Enriched compost, T2 (optimal) = Soil + Optimal compost, T3 (FYM) = Soil + FYM, T4 (vermi) = Soil + Vermicompost, T5 (poultry) = Soil + Poultry Manure and T6 (piggery) = Soil + Pig Manure and 9 days of incubation (DOI) were viz., 0, 7, 14, 28, 42, 56, 70, 84 and 98 days. All the organic manures were applied @ 5 t ha<sup>-1</sup>. During incubation, soil pH and EC increased and attained a maximum value at 28 and 42 days of incubation (DOI), respectively. Mean values of soil pH and EC ranged from 5.22 to 5.82 and 0.17 to 0.43 d S m<sup>-1</sup>, respectively. Due to the application of organic manures, the soil pH and EC varied from 5.31 (T0) to 5.72 (T5) and 0.19 (T0) to 0.39 (T5) d S m<sup>-1</sup>, respectively. Among the major nutrients release of Av. N (mg kg<sup>-1</sup>) increased during incubation and attained a maximum value at 14 DOI and then decreased. While a 2nd peak was attained at 70 DOI, after that a decrease was observed. Like nitrogen, release of Av. K (mg kg<sup>-1</sup>) also increased and attained a maximum value at 14 DOI and then decreased. But, during incubation, release of Av. P (mg kg<sup>-1</sup>) increased and attained its maximum value at 42 DOI and after that a decrease was recorded. Among the secondary nutrients, release of exchangeable (Ex) Ca and Mg decreased up to 42 DOI and up to 70 DOI, respectively, and after that the values increased. But, release of available S increased during incubation and attained a maximum value at 28 DOI and after that a decrease was observed. Among the micronutrients, release of DTPA-Fe increased up to 7 DOI and then decreased up to 56 DOI and then increased. Release of HW-B also decreased up to 42 DOI and then increased and attained a maximum value at 70 DOI. However,

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the release of DTPA-Mn and Cu increased during incubation and attained a peak value at 42 DOI and after that a decrease was observed. Release of DTPA-Zn also increased and attained its maximum value at 56 DOI after that it declined. Release of Av. N, Av. P and Av. K (Mean values) ranged from 73.33 to 189.03, 5.14 to 12.03 and 34.93 to 78.18 mg kg<sup>-1</sup>, respectively, at different DOI. Organic manure application, varied the release of Av. N, Av. P and Av. K (Mean values) from T0 (control) i.e., 54.13 to T6 (piggery) i.e., 136.40, T0 (control) i.e., 3.91 to T4 (vermi) i.e., 10.36 and T0 (control) i.e., 37.36 to T5 (poultry) i.e., 69.37 mg kg<sup>-1</sup>, respectively. Release of Ex-Ca, Ex-Mg and Av. S (Mean values) ranged from 255.24 to 387.6, 85.14 to 120.00, 10.62 to 19.23 mg kg<sup>-1</sup>, respectively, at different DOI. Due to organic manure application, the release of Ex-Ca, Ex-Mg and Av. S varied from T0 (control) i.e., 192.59 to T4 (vermi) = T3 (FYM) i.e., 374.81, T0 (control) i.e., 41.78 to T3 (FYM) = T4 (vermi) = T5 (poultry) i.e., 124.0 and T0 (control) i.e., 7.94 to T5 (poultry) i.e., 22.48 mg kg<sup>-1</sup>, respectively. During incubation, the release of DTPA- Fe, Mn, Zn, Cu and HW-B ranged from 15.33 to 33.78, 1.96 to 2.96, 1.98 to 2.87, 1.29 to 3.53 and 0.51 to 0.77 mg kg<sup>-1</sup>, respectively. Due to organic manure application the release of DTPA- Fe, Mn, Zn, Cu and HW-B varied from T0 (control) i.e., 14.78 to T3 (FYM) = T5 (poultry) i.e., 30.95, T0 (control) i.e., 1.40 to T1 (enrich) i.e., 2.89, T0 (control) i.e., 1.87 to T3 (FYM) i.e., 2.93, T0 (control) i.e., 1.52 to T2 (optimal) = T6 (piggery) i.e., 2.50 and T0 (control) i.e., 0.34 to T5 (poultry) i.e., 0.65 mg kg<sup>-1</sup>, respectively. The nutrients released from organic manure amended soil and from organic manure alone (Net release) better fitted in polynomial (2nd order) kinetic equation. However, K release from organic manure amended soil (total release), Mg release from T3 (FYM) and T4 (vermi) alone (net release), Mn release from T4 (vermi) amended soil and B release from T5 (poultry) and T6 (piggery) amended soil showed best fit in first order, second order and polynomial (second order) kinetic equations. Among the major nutrients, the net mineralization per cent of primary nutrients ranged from 2.83 to 10.46 for N, 0.17 to 0.52 for P and 0.82 to 10.37 for K, secondary nutrients varied from 13.24 to 20.46 for Ca, 48.79 to 84.72 for Mg and 1.06 to 1.71 for S and micronutrients ranged from 6.36 to 11.43 for Fe, 1.98 to 4.06 for Mn, 2.01 to 4.08 for Zn, 9.26 to 39.62 for Cu and 5.66 to 11.65 for B. Based on the net mineralization (%) from organic manures, total and net nutrient release during incubation, potentially mineralizable fraction and rate of nutrient release, the best source seemed to be Enriched compost for Ca, S and Mn. Optimal compost for Fe and Cu. Farm Yard Manure for P, K, Ca, Mg, S, Fe, Mn and Zn. Vermicompost for N, P, K, Ca, Mg, Mn and Zn. Poultry manure for K, Ca, Mg, S, Fe and B. Pig manure for N, Fe, Cu and B.

# **Geospatial Assessment of Soil Erodibility and Land Irrigability in a Transect of Simen River Basin of Assam**

*Baishaali Sarma*

An investigation was carried out to assess soil erodibility and land irrigability in a transect of Simen river basin, using remote sensing and GIS techniques. Based on Resourcesat-1 LISS-IV satellite data, three distinct landform units were delineated in the study area which includes: Piedmont plain, Alluvial plain and Flood plain covering an area of 41.32 sq. km, 50.71 sq. km. and 87.82 sq. km, respectively. Geo referenced surface soil samples (both bulk and core) were collected from the study area which were analyzed for various physico-chemical, hydro-physical, fertility and erosion related properties. Water samples of Simen river basin were also collected for analyzing various quality parameters. Various thematic maps pertaining to important hydrophysical properties along with soil and nutrient erosion were generated under ARC GIS environment. Texturally the soils varied widely from loamy sand to silty clay loam, while single grain, massive and sub angular blocky structure were found to be dominant in the study area. A decreasing trend of total sand (13.95-82.10 %) and fine sand (9.38-53.55%) from piedmont plain towards flood plain was found contrary to which silt (7.41-52.55 %) and clay (6.25-40.60%) were more prevalent in the flood plain. The bulk density of the soils ranged from 1.07 to 1.65 Mg/m<sup>3</sup> and the particle density exhibited a range from 2.20 to 2.75 Mg/m<sup>3</sup>. The porosity of the soils varied from 34.26 to 55.64 per cent. The hydraulic conductivity of the soils in the studied basin varied from 0.57 cm/hr to 8.70 cm/hr. The water holding capacity of the soils ranged from 14.12 to 53.07 per cent. The value of field capacity, permanent wilting point and available water content of soils in the studied area varied from 8.85 to 37.14, 2.49 to 18.33 and 4.73 to 25.90 per cent, respectively. Hydrological properties like porosity, water holding capacity, field capacity, permanent wilting point and available water content were found to be higher in the lower elevation area. The pH and electrical conductivity of the analyzed soil samples ranged from 4.75 to 6.53 and from 25.10 to 475  $\mu$ s/cm, respectively. The organic matter content of the studied soils ranged from 3.86 to 16.50 g

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kg <sup>-1</sup> and the total nitrogen content varied between 0.03 to 0.19 per cent. Total phosphorus content of the soils ranged from 0.01 to 0.05 per cent. Total potassium content of the studied area was found to be varying from 0.97 to as 2.78 per cent. The available nitrogen, phosphorus and potassium in the analyzed soil samples varied from 62.72 to 286.16 kg ha<sup>-1</sup> ; 10.00 to 58.40 kg ha<sup>-1</sup> and 40.23 to 293.66 kg ha<sup>-1</sup> , respectively. Organic matter, total nitrogen and available nitrogen were found to be maximum in the flood plain. Chemical properties like exchangeable sodium percentage, base saturation, cation exchange capacity, exchangeable calcium, magnesium, sodium, potassium and calcium carbonate showed an increasing trend towards lower elevation areas. The macroaggregate of studied soils varied from 12.45 to 67.20 per cent, while the microaggregate ranged from 32.80 to 87.55 per cent. The mean weight diameter of soils of the studied area ranged from 1.15 to 2.55 mm. Erodibility indices such as clay ratio, silt/clay ratio, modified clay ratio, dispersion ratio, erosion ratio and erosion index of the soils were found to decrease towards flood plain. The annual soil loss was found to be maximum in the piedmont plain followed by alluvial plain and flood plain. However nutrient erosion was found to be maximum in the alluvial plain. It was observed that 20.25 per cent area of the Simen river basin was severely eroded, while 0.38 per cent area was very severely eroded. Land suitability classification for irrigation revealed that 39.87 per cent of the total area was observed to be highly suitable (S1), 60.07 per cent of the area was found to be moderately suitable (S2) while, 0.07 per cent of the area was marginally suitable. Water quality parameters such as pH, electrical conductivity, total dissolved oxygen, chemical oxygen demand, total dissolved solid, total soluble solid, turbidity, chloride, carbonate, bicarbonate, calcium, magnesium, total hardness, residual sodium carbonate, arsenic and fluoride were analyzed for 12 ground water and 2 surface water samples and found to be under permissible range of FAO irrigation water guidelines with mean values of 6.84, 0.026 ds/m, 3.77 mg/l, 12.28 mg/l, 117.07 mg/l, 11.77 mg/l, 5.89 NTU, 45.39 mg/l, 16.86 mg/l, 152.79 mg/l, 36.44 mg/l, 3.33 mg/l, 39.77 mg/l, 0.97 me/l, 6.82 (ppb) and 0.423 mg/l, respectively except five samples for residual sodium carbonate. The water quality index of groundwater was found to be slightly higher than the surface water in the study area. Based on the water quality index value, both the surface water and groundwater of the study area could be categorized under Class I with no restriction for uses in irrigation purpose.

## **Soil fertility status in relation to fallow cycle in shifting cultivated areas of Dima Hasao**

*Baosring Nunisa*

The present investigation was carried (2019-20) to study the effect of jhum fallow cycle on soil properties in the DIMA HASAO district of Assam. Total of 120 geo-referenced soil samples were collected from short jhum (1-3 yrs.) fallow cycle, medium jhum (4-6 yrs.) fallow cycle, long jhum (7-9 yrs.) fallow cycle and undisturbed soil. The collected soil samples were analyzed for parameters like pH, OC, N, P, K, S, Ca, Mg, CEC, HWS-B, and soil texture. The studied soil samples showed wide variations in texture varying from sandy loam to clay loam. Coarse texture sand was found to be dominant in short jhum and medium jhum while finer particles (silt and clay) were dominant in the long jhum and the undisturbed soil. The Soil pH was found lowest (mean value 4.55) in short jhum and highest (mean value 5.00) in the undisturbed soil. The OC content was minimum at initial short jhum fallow cycle (mean value 0.98%) and maximum was observed in the Undisturbed soil (mean value 1.55%). The CEC of the study area was found highest in undisturbed soil [mean value 8.64 cmol (p+) kg<sup>-1</sup> ] followed by long jhum [mean value 7.98 cmol (p+) kg<sup>-1</sup> ] medium jhum [6.83 cmol (p+) kg<sup>-1</sup> ] and finally by short jhum [mean value 6.53 cmol (p+) kg<sup>-1</sup> ]. The Avl. N content of the study area was found low to medium. Among the jhum fallow cycle Avl. N of short jhum was lowest (mean value 269.30 kg ha<sup>-1</sup> ) followed by medium jhum (mean value 285.64 kg ha<sup>-1</sup> ), long jhum (mean value 335.84 kg ha<sup>-1</sup> ) and highest in undisturbed soil (mean value 350.11 kg ha<sup>-1</sup> ). The Avl. P content of the study area was found low to medium. Among the jhum fallow cycle, highest (mean value 12.61 kg ha<sup>-1</sup> ) was observed in long jhum fallow cycle followed by Undisturbed soil (mean value 12.03 kg ha<sup>-1</sup> ), medium jhum (mean value 9.55 kg ha<sup>-1</sup> ) and lowest in short jhum (mean value 9.33 kg ha<sup>-1</sup> ). The available K content was found medium to high. Among the jhum soil the lowest mean value was observed in short jhum (169.46 kg ha<sup>-1</sup> ) followed by medium jhum (217.89 kg ha<sup>-1</sup> ), long jhum (244.02 kg ha<sup>-1</sup> ) and the highest in the undisturbed soil (264.40 kg ha<sup>-1</sup> ). The highest content of Avl. S was observed in long jhum fallow cycle (mean value 17.48 kg ha<sup>-1</sup> ) followed by undisturbed soil (mean value 17.32 kg ha<sup>-1</sup> ), medium jhum (mean value 16.09 kg ha<sup>-1</sup> )

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and lowest in the short jhum (mean value 13.43 kg ha<sup>-1</sup> ). The highest of Ex. Ca was found in the undisturbed soil [mean value 1.78 cmol (p+) kg<sup>-1</sup> ] followed by long jhum [mean value 1.46 cmol (p+) kg<sup>-1</sup> ], short jhum [mean value 1.40 cmol (p+) kg<sup>-1</sup> ] and lowest in the medium jhum [mean value 1.37 cmol (p+) kg<sup>-1</sup> ]. The highest value of Ex. Mg was found in the undisturbed soil [mean value 1.19 cmol (p+) kg<sup>-1</sup> ] followed by long jhum [mean value 1.09 cmol (p+) kg<sup>-1</sup> ], short jhum [mean value 0.60 cmol (p+) kg<sup>-1</sup> ] and the medium jhum [mean value 0.59 cmol (p+) kg<sup>-1</sup> ]. HWS-B was found highest in undisturbed soil (mean value 0.94mg ha<sup>-1</sup> ) followed by long jhum (mean value 0.81 mg ha<sup>-1</sup> ), medium jhum (mean value 0.70 mg ha<sup>-1</sup> ) and lowest in the short jhum fallow cycle (mean value 0.53 mg ha<sup>-1</sup> ). All the soil fertility parameters i.e., N, P, K, S, Ca, Mg, and B exhibited significant positive correlation with pH, OC, CEC, and percent Clay. The highest SQI was observed in the undisturbed soil 24.12 followed by long jhum 23.97, medium jhum 22.03 and lowest in the short jhum 21.46 fallow cycle. Thus, it could be concluded that the minimum jhum fallow cycle should be at least 7 to 9 years.

# **Characterization of Plant Growth Promoting Rhizobacteria (PGPR) from Rhizosphere Microbiome of *Tezpur Litchi* Growing Areas of Assam**

*Bonjuri Saikia*

*Tezpur Litchi* (*Litchi chinensis* Sonn.), known for its unique flavour, though grown in different parts of Assam, the same quality and taste may not be assured in all places. This may be attributed to various biotic and abiotic factors, including the abundance of below ground microbial diversity. In the present investigation, native plant growth promoting rhizobacteria (PGPR) from rhizosphere microbiome of *Tezpur Litchi* were characterized and screened for their plant growth promoting (PGP) traits. Five different locations, viz., Tezpur litchi orchard Porowa, Napaam, Tezpur, Aujari progeny orchard and seed farm (APOSF), Morigaon, Farmer's training centre (FTC), department of Horticulture and food processing, Byrnihat, Rangolu nursery, Nagaon and Tingrai, Dibrugarh and KVK, Dibrugarh were selected where Tezpur litchi is grown. The soil chemical analysis across all the locations revealed low to medium range of available N and, available P<sub>2</sub>O<sub>5</sub>, while available K<sub>2</sub>O was found to be in medium range. An acidic range of pH was recorded in all the locations, with medium to high organic carbon content (OC). In *Tezpur litchi* orchard, Napaam an acidic range of pH with mean values of OC, available N, available P<sub>2</sub>O<sub>5</sub> and available K<sub>2</sub>O as 0.89%, 175.11 kg ha<sup>-1</sup>, 18.21 kg ha<sup>-1</sup> and 169.48 kg ha<sup>-1</sup>, respectively, was recorded. Soil biological properties like microbial biomass carbon and soil enzymes (fluorescein diacetate and phosphomonoesterase) were also estimated in all the areas which indicated microbial activity across all sites, in spite of heavy application of chemical fertilizers. From the five locations, a total of seventy-four putative bacterial isolates comprising of aerobic nitrogen fixers (ANF) (16 nos.), microaerophilic nitrogen fixers (MNF) (19 nos.), nutrient solubilizers like phosphate solubilizing bacteria (PSB) (6 nos.) and potassium solubilizing bacteria (KSB) (5 nos.), and endophytic bacteria (28 nos.) were isolated in their specific medium, including thirty-two isolates from *Tezpur litchi* orchard, Napaam. All the isolates exhibited PGP traits. The phytohormone, indole acetic acid (IAA) was secreted by the bacterial isolates in the range of 3.36-42.36 µg mL<sup>-1</sup> culture filtrate,

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while gibberellic acid (GA) was secreted in the range of 4.57-32.14  $\mu\text{g mL}^{-1}$  culture filtrate. The total nitrogen (TN) content of the isolates ranged between 4.90-12.61 mg g<sup>-1</sup> sucrose consumed in N-free media. Whereas in Tezpur litchi orchard, Napaam the mean IAA, GA and TN content was recorded to be 14.87  $\mu\text{g mL}^{-1}$  culture filtrate, 14.59  $\mu\text{g mL}^{-1}$  culture filtrate and 8.09 mg g<sup>-1</sup> sucrose consumed, respectively. 56.75% of the PGPR isolates could solubilize tricalcium phosphate in Pikovskaya's media indicating phosphate solubilization, while 60.81% of the isolates showed halo zone in modified Pikovskaya's media indicating zinc solubilization. Nine isolates showed positive results for siderophore production, however, hydrocyanic acid production was exhibited by only 6.75% of the isolates. Out of the isolates retrieved from Tezpur litchi orchard, Napaam, 53.12%, 59.37%, 9.37% and 6.25% showed positive results for phosphate solubilization, zinc solubilization, siderophore production and HCN production, respectively. The intrinsic antibiotic resistance (IAR) profile of the isolates showed varied resistance to common antibiotics. Based on the highest quantitative estimation of TN of the isolates, three ANF, viz., T/ANF-7, T/ANF-8 and D/ANF-2 which produced 10.16, 9.77 and 9.72 mg g<sup>-1</sup> sucrose, respectively and four MNF (B/MNF-1: 12.61, M/MNF-1: 12.50, T/MNF-4: 11.77 and N/MNF-1: 11.77 mg g<sup>-1</sup> sucrose) were selected for biochemical characterization. Two nutrient solubilizers T/NSP-1 and M/NSK-1 were also selected for biochemical tests on the basis of highest Khandeparkar's ratio of 2.85 and 2.42, respectively. Three endophytic bacteria T/ENDO-10, B/ENDO-2 and M/ENDO-3 were selected on the basis of IAR profile. Finally, twelve PGPR isolates were selected for various biochemical tests, and the varied results exhibited by the PGPR isolates indicated their presence and adaptability in wide ecosystem. Among the selected isolates, five isolates (T/ANF-7, T/ANF-8, T/MNF-4, T/NSP-1 and T/ENDO-10) from *Tezpur litchi* orchard, Napaam were screened with better PGP traits, thus indicating that these isolates may play pivotal role in modulating the rhizosphere environment of *Tezpur Litchi*.

## Assessment of Chemical Properties of Litchi Growing Soils of Assam

*Chittadeep Nath*

The present experiment entitled “Assessment of chemical properties of litchi growing soils of Assam” was framed to assess the chemical properties of soils of litchi growing areas in Assam and to study the changes in chemical properties and nutrient content of soils under laboratory incubation. The chemical properties of the surface (0-20 cm) and sub surface (20-40 cm) soil samples from litchi orchards of three agroclimatic zones of Assam viz., NBPZ (Tezpur), CBVZ (Nagaon) and LBVZ (Kamrup) were assessed for Piyaji, Bombaya and Elaichi varieties. The soil properties, except exchangeable  $\text{Na}^+$ , significantly differed among the locations. The soil texture ranged from sandy loam in Tezpur to sandy clay loam in Nagaon and clay loam in Kamrup. The lowest pH and organic carbon content were observed at Kamrup and differed significantly from Tezpur and Nagaon for both surface and sub surface soils. Irrespective of soil depth, the  $\text{NH}_4\text{-N}$ ,  $\text{NO}_3\text{-N}$ , exchange acidity, exchangeable  $\text{Al}^{3+}$ , total acidity and cation exchange capacity (CEC) was significantly higher in the soils of Kamrup. The highest available P and K at 0-20 cm and 20-40 cm were observed in the soils of Nagaon. There was no significant difference in soil pH, organic carbon, exchangeable  $\text{Ca}^{2+}$  and  $\text{K}^+$  between Tezpur and Nagaon, however the former exhibited significantly lower soil acidity parameters, CEC and exchangeable  $\text{Mg}^{2+}$  contents. The surface soil samples of Tezpur, Nagaon, Morigaon and Kamrup were incubated with different doses of lime requirement (LR), viz. 0% LR (No lime), 50% LR and 100% LR with (RDF) or without (unfertilized) application of recommended doses of fertilizer for 89 days. Application of lime increased soil pH and the highest value after 89 days of incubation was observed in Tezpur (6.23) and the lowest in Kamrup (6.12). The lime application reduced the soil exchange acidity and exchangeable  $\text{Al}^{3+}$  during the incubation in all the locations, but the change was small in Tezpur i.e., 0.69 & 0.73 [ $\text{cmol}(\text{p}^+) \text{kg}^{-1}$ ], respectively. The addition of lime increased the exchangeable Ca & Mg and decreased exchangeable  $\text{Na}^+$  in all the locations during the incubation. The application of 100%LR had a significant effect on the increase in exchangeable K over 50%LR in all the locations. The positive effect of liming on  $\text{NH}_4^+\text{-N}$  &  $\text{NO}_3^-\text{-N}$  was more pronounced in Tezpur compared to other locations. The application of lime increased

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available P in soil up to the 64th day of incubation and decreased thereafter. In the case of available K, it continued to increase up to 89 days after liming, which coincides with the stone hardening stage of fruit development. An increase in the availability of P & K was found maximum in the soils of Tezpur. The addition of RDF reduced the soil pH, exchangeable Ca, Mg & K and increased exchange acidity and exchangeable  $Al^{3+}$  in all the locations. Application of RDF increased the  $NH_4-N$ ,  $NO_3-N$ , available P & K in all the locations during the incubation period. The litchi growing orchards of Tezpur, Nagaon and Kamrup significantly differed in soil chemical properties. Application of recommended dose of fertilizer with liming had positive changes in soil chemical properties and needs to be correlated with a nutrient concentration in leaf and fruit and fruit quality.

## **Distribution of Arsenic in Rice Soils of Titabar, Jorhat**

*Denim Bora*

The present investigation was carried out to study the distribution of Arsenic in relation to the pedogenesis of rice growing soils of Titabar circle of Jorhat district and to assess its bioavailability. To accomplish the objectives four locations (Nangal Gaon, Bosa Gaon, Lahong Bebejia, and Sologuri) were selected covering the entire circle and a soil profile was exposed in each location. In addition to the soil samples collected from eighteen numbers of horizons of four profiles, five numbers of composite surface soil samples (0-20 cm) and equal numbers of groundwater and rice plant samples were also collected from each location. The soils were gray to brownish-yellow in colour and varied widely in texture (sandy loam to silty clay), sand content (12.8 – 63.8%), silt (17.6- 50.8%), clay (15.8-46.6%), and OC (0.38 – 0.91%). Soil structure was mostly sub-angular blocky with massive at the surface. Soils were strongly to medium acidic in reaction (pH 5.15-5.83) with low CEC (7.5-9.7) and base saturation (36.3 – 48.3%). Based on the morphological and Physico-chemical properties, the soils of P1(Nangal Gaon) and P3 (Lahong Bebejia) were classified as Typic Endoaquepts and Aquic Dystrudepts respectively. The soils of both P2 (BosaGaon), and P4 (Sologuri) were classified as Oxyaquic Dystrudepts. The crystalline Fe and Al fractions of the soils varied from 1.17- 2.11% and 0.37-0.82% respectively. The content of amorphous Fe and Al fractions was low with a range from 0.32-0.76% and 0.18-0.54% respectively. The P2 (BosaGaon) was recorded for the highest weighted mean of all the forms of Fe and Al. Considerable variation was observed in the total As content of the soils which ranged from 11.18 to 20.75 mg kg<sup>-1</sup> . The highest weighted mean of total As was measured in P4 (20.22 mg kg<sup>-1</sup> ) followed by P2 (17.48 mg kg<sup>-1</sup> ), P1 (14.54 mg kg<sup>-1</sup> ), and P3 (13.65 mg kg<sup>-1</sup> ). The distribution of total As in the soil profiles was found to be mostly influenced by the particle size fractions and different forms of Fe and Al. Thus As in these soils can be considered geogenic in origin as it was found to be regulated by the soil properties inherited from the parent material. The bioavailability of As was evaluated through fractionation of soil As by the sequential extraction method. The content of (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, NH<sub>4</sub>H<sub>2</sub>PO<sub>4</sub>, NH<sub>4</sub>-Oxalate Buffer, NH<sub>4</sub>-Oxalate buffer with Ascorbic Acid, and residual As in the soils were ranged from 0.27-0.49 mg kg<sup>-1</sup> , 0.67-

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1.61 mg kg<sup>-1</sup> , 2.94-6.15 mg kg<sup>-1</sup> , 2.38-4.47 mg kg<sup>-1</sup> and 1.16-3.17 mg kg<sup>-1</sup> respectively. Among all the fractions As bound to amorphous materials (NH<sub>4</sub>-Oxalate Buffer) was found to be the most dominant fraction followed by As bound to crystalline compounds (NH<sub>4</sub>-Oxalate buffer with Ascorbic Acid), residual fraction, the specifically adsorbed fraction (NH<sub>4</sub>H<sub>2</sub>PO<sub>4</sub>,) and readily soluble fraction ((NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>). Similar to total As, the different fractions of soil As were also found to be influenced by the particle size fractions and different forms of Fe and Al. A highly dynamic relationship was observed among all the As fractions in the studied soils indicated a strong replenishment mechanism. The total As content determined in the composite surface soil samples was varied from 10.27-17.52 mg kg<sup>-1</sup> and it was significantly higher in soils of Nagal gaon (14.92 mg kg<sup>-1</sup> ) and Bosagaon area (15.29 mg kg<sup>-1</sup> ) than Lohong Babejia (11.39 mg kg<sup>-1</sup> ) and Sologuri area (11.63 mg kg<sup>-1</sup> ). The content of As in groundwater and rice grain were varied from 101.5 -221.6 µg L<sup>-1</sup> and 0.517-0.966mg kg<sup>-1</sup> respectively. Significantly the highest groundwater concentration of As was measured in Sologuri (216.4 µg L<sup>-1</sup> ) followed by Bosa gaon (120.9 µg L<sup>-1</sup> ), Lohong Bebejia (112.6 µg L<sup>-1</sup> ), and Nangal gaon area (103.1 µg L<sup>-1</sup> ). The groundwater As content showed a significant negative relationship with the total As content of soils but maintained a highly positive relationship with As content of rice grains. The groundwater and rice grain As content did not show any relationship with the fractions of As in A horizon but showed a highly positive relationship with F2, F3, F5, and total As of B horizon. The path diagram indicated the maximum contribution of specifically adsorbed As fraction (F2) towards the readily soluble fraction of As followed by crystalline (F4) and residual fraction (F5).

## **Hydrophysical properties and erodibility of Brahmaputra river bank soils under Golaghat district**

*Dipsikha Goswami*

The study on the hydrophysical properties and erodibility of Brahmaputra river bank soils under Golaghat district was carried out with the objectives 1) To assess hydrophysical and chemical properties of soils along the bank of Brahmaputra river and 2) To estimate soil erodibility indices of the studied soils. The studied area is located in the Golaghat district which is a part of Upper Brahmaputra Valley Zone of Assam. It encompasses an area of 195.52 sq. km and lies between 93°71' E to 93°99' E longitude and 26°67' N to 26°80' N latitude and with an elevation ranging from 79 to 84 m. Thirty eight surface soil samples (0-15 cm) both disturbed and core were collected using handheld GPS of Garmin Etrex 20 upto 5 km from the bank of Brahmaputra river towards southern direction. The sampling sites were demarcated across the flow of Brahmaputra river traversing a total distance of 25-30 km from East to West. The surface as well as core samples were analysed for various hydrological and chemical properties following the standard procedures. The studied soils exhibited soil texture ranging from loamy sand to silty clay loam, however, silt loam was the dominant one. The amount of silt and clay content were found to be somewhat higher than sand content in the areas away from the river bank and reverse trend persisted in case of total sand content. The bulk density, particle density of investigated soils ranged from 1.22 to 1.59 Mg m<sup>-3</sup> with a mean value of 1.37 Mg m<sup>-3</sup> and 2.31 to 2.65 Mg m<sup>-3</sup> with a mean value of 2.47 Mg m<sup>-3</sup> respectively. The porosity of the studied soils ranged between 32.63 to 49.03 per cent, while the hydraulic conductivity ranged between 0.29 to 1.34cm hr<sup>-1</sup>. The water holding capacity ranged from 21.45 to 45.01 per cent while the field capacity, permanent wilting point and available water content values varied from 17.78 to 33.12 per cent, 4.45 to 13.03 per cent and 6.26 to 24.02 per cent respectively. The studied soils showed significant positive correlation of water holding capacity, field capacity with clay which exhibited that dominance of finer particles increases the capillary pores and maximum surface area to hold water. Hydraulic conductivity showed significant

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negative correlation with clay and exhibited high values of hydraulic conductivity in the soils where clay content is low or finer materials being migrated due to erosion. The macro aggregates, micro aggregates and mean weight diameter of the studied soils varied from 41.93 to 84.07, 15.93 to 58.07 per cent and 0.72 to 3.88 mm, respectively. The studied soils were acidic in nature and the pH of the soils ranged between extremely acidic (4.45) to slightly acidic (6.74) with a mean value of 5.56. The organic matter of the studied soil area varied from 0.94 to 2.62 per cent with a mean of 1.77 per cent. The mean values of available nitrogen, available phosphorus, available potassium content of soils were 288.42, 44.37, 84.71 kg ha<sup>-1</sup> respectively and their status ranged from low to medium. On the basis of the estimated values of soil physico-chemical properties, various soil erodibility indices were computed. The silt/clay ratio, clay ratio and modified clay ratio in the studied soils ranged from 0.75 to 2.43, 1.30 to 7.36 and 1.23 to 6.79, respectively. Among the dispersion ratio, erosion ratio and erosion index, dispersion ratio ranged from 0.05 to 0.33 with a mean of 0.17, erosion ratio ranged from 0.03 to 0.18 with a mean of 0.08 and erosion index ranged from 0.03 to 0.32 with a mean of 0.10 respectively. EIROM values ranged from 0.60 to 3.96 with a mean of 1.15 and it exhibited similar trend like EI as showed significant positive correlation with very fine sand and significant negative correlation with clay content. The values of soil erodibility factor in the studied soils ranged from 0.09 to 0.12 with a mean of 0.10. GIS based schematic mapping revealed that among the physical properties total sand covered highest area nearly 134.64 sq. km (68.86 per cent) of the studied area in the range of total sand content less than 25 per cent. Silt content range 40-50 per cent covered the highest area nearly 137.80 sq. km (70.48 per cent) of the studied area which were away from the river bank. Clay content exhibited highest area nearly 109.86 sq. km (56.18 per cent) in the clay content range of 30-35 per cent and among the hydraulic properties , available water content covered highest area i.e 116.55 sq km (59.61 per cent) in the range of 15-20 per cent, hydraulic conductivity range 0.5-0.75 cm hr<sup>-1</sup> covered highest area nearly, 123.70 sq km (63.27 per cent), field capacity values in the range of 20-25 per cent covered highest area i.e 116.55 sq km (59.61 per cent) of the studied soil area. Water holding capacity values in the range of 35-40 per cent covered highest area i.e 116.55 sq km (59.61 per cent) of the studied soil area. Macroaggregates recorded highest area nearly 147.09 sq. km (75.23 per cent) of the studied area in the macroaggregate content range 75-80 per cent. Nearly 3.9 sq. km (2 per cent) of the studied area had dispersion ratio value more than 0.15 which could be considered as erodible. About 12.05 sq. km (6.16 per cent) of the studied area had erosion ratio values more than 0.10 indicating their susceptibility to erosion. The erosion index values were more than 0.15 in about 3.9 sq. km (2 per cent) of the studied area.

## **Assessment of earthworm cast quality in different land uses of Assam**

*Mousumi Dutta*

A study on 'Assessment of Earthworm Cast Quality in different land uses of Assam' was conducted during 2019-2021 with the objectives to access the physical, chemical, and biological properties as well as heavy metals for evaluating the overall quality of Turret Cast (TC) and Mass Cast (MC) to adjacent soils in seven land use systems namely Agricultural Land (Kharif), Agricultural Land (Vegetables), Agricultural Land (Double Cropped), Agricultural Plantation (Horticultural Orchard), Agricultural Plantations (Tea Garden), Forest (Moist Mixed Deciduous Dense) and Forest (Moist Mixed Deciduous Open). Physico-chemical and biological properties were analysed for evaluation of Soil Quality Index (SQI) following Simple Additive, Weighted Additive, and Principal Component Analysis (PCA) approaches. Both TC and MC accounted for higher percent silt and clay, Water Stable Aggregates (WSA), Mean Weight Diameter (MWD), moisture, pH, EC, Organic Carbon, CEC, available N, P, K, exchangeable Ca and Mg, Microbial Biomass Carbon, Dehydrogenase activity and Total Bacterial Count compared to their adjacent soils while reverse results were observed for Bulk density and Heavy metals. Test of significance for physical properties within and across all the four groups interacted significantly AS(T) with MC, and AS(M) with MC for clay and moisture content; AS(T) with AS(M), AS(T) with TC, TC with MC and AS(M) with TC and MC for WSA and MWD except for AS(T) with TC; AS(T) with AS(M) and MC, and AS(M) with TC for BD. For chemical parameters, the significant difference between AS(T) and AS(M) was observed in EC, OC, and K; AS(T) and TC in pH, EC, N, P, K, and Ca; AS(T) and MC in EC, CEC, N, P, K; AS(M) and TC in pH, EC, N, P, K, Ca, Mg; AS(M) and MC in CEC, N, P; and TC and MC in respect of pH, EC, OC, K, Ca and Mg, respectively. The heavy metal contents differed significantly between AS(T) and AS(M) for Cu; AS(T) and TC for Fe and Mn; and AS(T) and MC for Fe, Cu and Ni; AS(M) and TC for Fe and Cu; AS(M) and MC for Fe, and TC and MC for Cu content. Among the biological parameters, the significant differences in respect of MBC were recorded in AS(T) with AS(M), AS(T) with TC, AS(T) with MC, AS(M) with TC, and AS(M) with MC, while for TBC, it was recorded in AS(M) with

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TC, and TC and MC, respectively. Favourable soil physico-chemical properties were recorded in two land uses F(MMDD) and F(MMDO) while it was in AL(K), AL(V), AL(DC) for other heavy metals. Soil Quality Index (SQI) over all the parameters depicted comparatively the higher SQI in both the casts over the respective adjacent soils and TC tended to record higher SQI than MC.

# **Implications of Aluminium and Fluoride in Plucked Tea Leaves and Soils of Doomdooma Area in Assam**

*Namrata Rajbonshi*

Tea (*Camellia sinensis* L.) plant, a potential bio-accumulator of Aluminium (Al) and Fluoride (F) is the most popular beverage in the world, and concentrations beyond threshold levels might cause an adverse effect that otherwise has a beneficial impact on human health. The distribution of Al and F, their fractionations, and the relationship in tea plants, soils, and groundwater of 12 tea gardens in the Doomdooma area of the Tinsukia district of Assam were investigated. The soil textures of the selected gardens were sandy loam, loam, silty loam, and sandy clay loam. Bulk density and pH ranged from 1.45 to 1.50 g cc<sup>-1</sup> and 4.68 to 5.15, respectively with an increasing trend with depth. Organic carbon, CEC, available N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O ranged from 0.55 to 0.66%, 9.43 to 12.64 [cmol(p+)/kg], 218.21 to 290.46kg ha<sup>-1</sup>, 18.32 to 21.92kg ha<sup>-1</sup> and 210.92 to 290.21kg ha<sup>-1</sup>, respectively tending to decrease the value down the depths. Among soil Al fractionations water soluble Al ranged from 0.72 to 0.88mg kg<sup>-1</sup> decreasing the content down the soil depth with significant differences between all the three depths. Exchangeable Al ranged from 10.45 to 29.31mg kg<sup>-1</sup> decreasing the value down the soil depths recording a significant difference between 0 - 20cm and 40 - 60cm. The organic Al fractions across the gardens varied from 22.98 - 26.59mg kg<sup>-1</sup> and tended to decrease significantly with increasing soil depths. Fe-Mn oxide bound Al ranging from 87.38 to 99.69mg kg<sup>-1</sup> increased significantly with soil depth. Water soluble, exchangeable and organic fluoride fractions ranged from 0.55 to 0.75mg kg<sup>-1</sup>, 1.24 to 1.42 mg kg<sup>-1</sup>, and 21 to 1.79mg kg<sup>-1</sup>, respectively, and tended to decrease significantly with soil depths. Fe-Mn oxide bound fluoride varied from 1.73 to 2.64mg kg<sup>-1</sup> and its content was found to increase significantly down the soil depths. Both Al and F contents in plant parts revealed their highest content in old leaves followed by young leaves and stems that existed in between the young and old leaves. The highest significant positive correlation was recorded between made tea and young leaves for Al ( $r = 0.876^{**}$ ) and F ( $r = 0.911^{**}$ ). The infused tea prepared with distilled water showed a significant positive correlation with made tea for Al ( $r = 0.624^*$ ) and F ( $r = 0.798^{**}$ ).

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Groundwater Al and F ranged from 1.22 to 2.10mg L<sup>-1</sup> and 0.13 to 0.66 mg L<sup>-1</sup> , respectively, and no significant effect was recorded on soil and plant Al and F content. Regression analysis revealed that soil Al and F fractions had 73.5 and 63.8 percent contribution on Al and F content in made tea, whereas percent contribution from different plant parts for Al and F on made tea was 61.4 and 87.2, respectively. The algorithm for cognitive assessment study provided by Alzheimer's Association revealed indications of partial cognitive impairment in 7 gardens namely Budlabeta, Dangori, Hokonguri, Hatijan, Khobong, Longsual, and Laina which necessitates conducting full dementia evaluation and medical attention.

## **Soil Boron fractions as influenced by selected soil properties and cropping system in Boko block of Kamrup (Rural) district of Assam**

*Neelom Baruah*

The present study was conducted with the twin objective to assess the influence of basic soil physico-chemical properties and cropping system (CS) on soil boron fractions in Boko Block of Kamrup (Rural) District of Assam. A total of twenty- four (24) geo-referenced surface soil samples (0-15 cm) were collected from across the blocks under each cropping system viz., Rice-Rice, Rice- Fallow, Vegetable-Vegetable and Plantation crops. The soil groups were found to vary in their physico-chemical properties irrespective of cropping system practised. The studied soil samples showed wide variations in texture varying from sandy clay loam (SCL) to clay loam (CL). The ranges for pH, SOC (%), Av. Nitrogen (kg ha<sup>-1</sup>), Available P<sub>2</sub>O<sub>5</sub> (Kg ha<sup>-1</sup>), Available K<sub>2</sub>O (Kg ha<sup>-1</sup>), CEC [Cmol (p+) kg<sup>-1</sup>], EC (dSm<sup>-1</sup>) ranged between very strongly acidic to strongly acidic (4.7-5.6), medium to high (0.6-1.6 %), Low to Medium (175.6-326.4 kg ha<sup>-1</sup>), Low to High (5.93- 57.68 kg ha<sup>-1</sup>), Medium (130.8-276.2 kg ha<sup>-1</sup>), Low (2.8-9.6 Cmol (p+) kg<sup>-1</sup>), Normal range (0.01- 0.03 ds m<sup>-1</sup>) respectively. The selected properties viz., CEC, pH and SOC were chosen based on past research findings to analyze its effect on soil boron fractions. Each of the three parameters were split in two groups: CEC (two groups-2.8-5.8 and 5.9-9.6 C mol(p+) kg<sup>-1</sup>), pH (two groups-4.7-5.0 and 5.1-5.6) and SOC (two groups- 0.6-1.0 and 1.1-1.6 %). The data was analyzed using independent sample t-test. It was found that pH and CEC did not significantly affect soil B fraction. However, SOC had a significant effect on soil boron fraction viz., oxide bound and organic bound. In case of CS, majority of the soil properties viz., pH, soil organic carbon, available nitrogen, available phosphorus, cation exchange capacity, sand content (18.1- 49.5%) and silt content (24.1-48.4%) did not differ significantly among the cropping system. However, soil properties like available K<sub>2</sub>O content, EC, and clay (22.6-38.2%), was found to differ significantly between the cropping system. Cropping system did not significantly affect the various boron fractions in the present study. Significant positive correlation has been observed for soil organic carbon with Oxide bound B ( $r= 0.834^{**}$ ), Organically bound B ( $r= 0.541^{**}$ ),

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Specifically adsorbed B ( $r= 0.505^*$ ) and EC ( $r= 0.502^*$ ). A significant negative correlation has been observed in between sand and silt ( $r= -0.905^{**}$ ) as well in sand and clay ( $r= -0.587^{**}$ ) content among the CS. The available boron (0.56 to 1.69 mg kg<sup>-1</sup>) and five boron fractions viz., Readily Soluble Boron (0.04-2.41 mg kg<sup>-1</sup>), Specifically Adsorbed Boron (0.15-1.92 mg kg<sup>-1</sup>), Oxide Bound Boron (5.18-17.41 mg kg<sup>-1</sup>), Organically Bound Boron (6.86-20.3 mg kg<sup>-1</sup>) and Residual Boron (17.73- 36.57 mg kg<sup>-1</sup>) did not differ significantly between the cropping systems. Results revealed that the relative proportion of various fraction of boron in soils are in the following order i.e. readily soluble B < Specifically adsorbed B < Oxide bound B < Organically bound B < Residual B. The Soil Quality Index for each CS were in the order: Rice-Rice (16.752) > Rice-Fallow (14.645) > Veg-Veg (12.979) > Plantation (12.742). None of the measured parameters were found to be significantly correlated with the yield of crop under the studied cropping system. The study, therefore explores the possibility of soil physico-chemical influence on soil boron fractions owing to cropping system over long period of time. The study reveals the selected soil properties influence on soil B fractions and cropping system being a non- determinant influencing any of the boron fraction studied.

# **Bioresource potential of filamentous cyanobacteria from paddy fields of Assam and its evaluation**

*Nikita Laishram*

The present investigation was carried out to evaluate the bioresource potential of filamentous cyanobacteria from rice fields of Assam. Rhizospheric soil samples were collected randomly from Jorhat and Golaghat districts of rice rhizosphere. Altogether 77 cyanobacterial cultures were isolated from 55 numbers of soil samples using BG110 specific liquid media and 30 cultures thus showed pure colonies. The 30 selected cultures were morphologically characterised on the basis of thallus morphology, trichome, vegetative cell structure, presence or absence of heterocysts and akinetes. The results showed that the cultures were non identical to each other and morphological data and microphotograph thus revealed probable genera belonging to *Anabaena*, *Nostoc*, *Cylindrospermum* and *Calothrix*. The soil nutrient status and soil enzyme assays as influenced by the various cyanobacteria indicated variation among the soil from where cultures were isolated. The correlation studies revealed a positive correlation with pH, organic C and enzyme activities. Also enzyme activities was seen to be positively correlated with available N, P, K. The nitrogenase enzyme activity was determined using ARA and results revealed a range of 7.70- 26.19 C<sub>2</sub>H<sub>2</sub> nmol ml<sup>-1</sup> hr<sup>-1</sup> day<sup>-1</sup> and culture BGA- 41 showed as the efficient culture. All the isolated cyanobacterial cultures produced significant amount of phytohormones with IAA, GA and cytokinin. Most of the cyanobacterial cultures exhibited positive results for siderophore production, HCN production and proteolytic activity. Quantitative activities of P solubilization and ammonia production was highest shown by BGA- 41. The cyanobacterial isolates were further screened for 16S rRNA gene sequencing for species identification and also to study the phylogenetic relationships among the cultures. The dominant cultures followed as *Anabaena* > *Nostoc* > *Aliinostoc* > *Calothrix* > *Wolleea* > *Cranbergia* > *Cylindrospermum*. 10 efficient cultures based on enzyme and PGP activities were selected for pot experiment to study its efficiency in growth and yield attributing characters in rice crop variety Luit (Ahu). Results indicated that all the inoculated treatments showed better growth and yield as compared to the uninoculated control

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which was evident from the data obtained on number of tillers, number of panicles, length of panicles, grain yield (g/ hill), straw yield (g) and dry weight of root (g). Grain yield and straw yield of BGA- 41 ranged as 27.67 g/ pot and 12.64 g/ pot respectively. Therefore BGA- 41 was regarded superior to other cyanobacterial cultures which was at par with the recommended fertilizer dose treatment.

## **Influence of biochar on soil physico-chemical properties**

*Priyambi Saikia*

The study on „Influence of biochar on soil physico-chemical properties“ was conducted during 2019-2021 with the aim to characterize biochar obtained by pyrolysis of different organic sources, viz., ipomoea, rice straw and rice husk; and to study the influence of application of biochar on the physico-chemical properties of soils over a period of 90 days of incubation. Biochar was prepared by pyrolysis of organic sources under anaerobic condition at a temperature ranging from 350 to 400oC using the biochar kiln. pH, EC, CEC, available N, available P<sub>2</sub>O<sub>5</sub>, available K<sub>2</sub>O, water holding capacity (WHC) and bulk density of biochars ranged from 7.34 to 9.69, 0.70 to 1.13 dS m<sup>-1</sup>, 17.3 to 18.4 cmol(p<sup>+</sup>) kg<sup>-1</sup>, 0.0028 to 0.00504%, 0.0126% to 0.0258%, 0.17 to 0.34%, 101.58 to 255.36% and 0.267 to 0.465 Mg m<sup>-3</sup> respectively. Soil samples of three different textural classes, viz., clay, clay loam and sandy were collected from the Titabor subdivision of Jorhat district for the incubation study. Soil samples were incubated for 90 days at 60% FC with each type of biochar (ipomoea, rice husk and rice straw) at 4 different levels (1, 2, 3 and 4%) in a completely randomized design. Biochar improved soil physical properties like hydraulic conductivity, soil water retention at field capacity, soil water retention at permanent wilting point, soil available water, increased sand and silt sized particles, while it decreased the clay sized particles compared to the initial value of the soils. Rice husk and rice straw biochar significantly decreased the percentage of clay sized particles (2.73%), by significantly increasing the percentage of sand and silt sized particles. All three soils showed a proportionate increment in sand and silt sized particles, while clay sized particles declined with the increase in the rate of application of biochar from 1 to 4%. When applied at a rate of 4%, rice husk biochar significantly increased the percentage of sand sized particles by its maximum value (2.25%) and rice straw biochar significantly increased the percentage of silt sized particles by its maximum value (2.42%). Application of rice husk biochar significantly improved hydraulic conductivity of the soils to the highest value (7.73 mm hr<sup>-1</sup>). Application of biochar derived from ipomoea led to significantly higher water retention at field capacity (28.10%), water retention at permanent wilting point (10.94%) and soil available water content (17.16%). Biochar showed corresponding increase in hydraulic

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conductivity till the application rate of 3% for clay loam and sandy clay loam soil. At the application rate of 3% rice husk biochar resulted for the highest hydraulic conductivity of the soil (9.11 mm hr<sup>-1</sup>). Soil water retention at field capacity and permanent wilting point increased proportionately with increase in the rate of application of biochar from 1% to 4% for all 32 soils except for sandy clay loam soil where soil water retention at field capacity proportionately decreased. Application of biochar at the rate of 3% and 4% significantly increased the soil available water content to the highest value (17.19%). Ipomoea at the rate of 4% led highest water retention at field capacity (29.91%) and soil available water (18.43%). Biochar significantly altered the soil pH, EC, CEC, organic carbon, available nitrogen, phosphorous and potassium content of the soils. Rice straw biochar led to significantly higher pH (5.88), EC (0.093 dS m<sup>-1</sup>) and organic carbon content (1.11%). Ipomoea biochar prompted significantly higher CEC [9.80 cmol(p<sup>+</sup>) kg<sup>-1</sup>], soil available nitrogen (251.38 kg ha<sup>-1</sup>) and available potassium content (311.41 kg ha<sup>-1</sup>). Rice husk biochar led to significantly higher available phosphorous content (72.69 kg ha<sup>-1</sup>). Soil chemical properties such as pH, EC, organic carbon, CEC, available phosphorous and potassium content was significantly increased with the increasing rate of application of biochar from 1 to 4%. Application of 4% rice straw biochar increased the soil pH, EC and soil organic carbon content to the highest level (6.39, 0.120 dS m<sup>-1</sup> and 1.41% respectively). Ipomoea biochar at the rate of 4% led to highest CEC and soil available potassium content [11.07 cmol(p<sup>+</sup>) kg<sup>-1</sup> and 358.59 kg ha<sup>-1</sup> respectively]. Biochar made from rice husk at the rate of 4% increased the soil available phosphorous content to the highest level (96.06 kg ha<sup>-1</sup>). However, application of biochar till 2% resulted in increase in available nitrogen content of the soils. Further increase in application rate resulted in decrease in available nitrogen content of the soils. Ipomoea biochar at the rate of 2% increased the soil available nitrogen content to the highest level (271.71 kg ha<sup>-1</sup>).

## **Bioconversion of municipal solid waste into fortified compost using microbial mediators**

*Rinjim Sikha Bora*

Rapid composting of municipal solid waste (MSW) collected from two different sites (main landfill of Jorhat municipal corporation and dumping site of Rowriah, Jorhat, Assam), was done using three different decomposers microbial consortia group (DMC @1%) for 60 days, and thereafter biofortification of the MSW compost was done by addition of plant growth promoting rhizobacteria (PGPR) for 20 days. The DMC group were previously isolated from polluted sites of Assam, and denominated as paper group, oil group and cement group. For comparison with MSW, agro-waste was also used in the study, which did not receive DMC, but received PGPR application after 60 days. At 80 DAI (days after inoculation), pH was stabilized in the range between 7.40-7.76 in MSW I and 7.00-7.55 in MSW II, electrical conductivity (EC) was recorded to be in the range 3.08-5.21 dS m<sup>-1</sup> (MSW I) and 1.55-3.85 dS m<sup>-1</sup> (MSW II). The temperatures during composting period were maintained between 27.33-28.66°C in MSW I and 28.66-32.33°C in MSW II, while the moisture content decreased in both sites at 80 DAI. Following PGPR application, total carbon content declined to a minimum of 17.24-24.82% in MSW I and 17.52-27.7% in MSW II, while total nitrogen content increased to 1.01-1.7% in MSW I and 0.85-1.53% in MSW II. Total phosphorus and total potassium content also exhibited increasing trend till the end of composting. At 80 DAI, C:N ratio declined over uninoculated treatment in both sites and ranged between 10.37-15.90 (T1-T3) in MSW I and 12.26-13.13 (T1-T3) in MSW II. NO<sub>3</sub>-N elevated till the end of composting, contrarily, NH<sub>4</sub><sup>+</sup>-N declined to a minimum of 0.09-0.27% in MSW I and 0.08-0.27% in MSW II. CEC increased to 22.35-29.99 c mol (p<sup>+</sup>) kg<sup>-1</sup> in MSW I and 22.43-28.17% c mol (p<sup>+</sup>) kg<sup>-1</sup> in MSW II. Heavy metals, viz- Pb and Cd content decreased to 98.20-250 ppm (T1-T3) and 0.74-0.81 ppm (T1-T3) during PGPR fortification. Total bacterial count of the fortified compost was displayed at 6.17 to 7.01 Log cfu g<sup>-1</sup> in MSW I and 6.16 to 6.93 Log cfu g<sup>-1</sup> in MSW II, while fungi population recorded at 4.81 to 6.03 Log cfu g<sup>-1</sup> in MSW I and 4.91 to 6.06 Log cfu g<sup>-1</sup> in MSW II. Actinomycetes population recorded at 6.70 to 6.99 Log cfu g<sup>-1</sup> in MSW I and 6.68 to 7.00 Log cfu g<sup>-1</sup> in MSW II at 80 DAI. Estimation of biologically important

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enzymes (phosphomonoesterase, dehydrogenase, arylsulphatase, and fluorescein diacetate hydrolysis) provided information on the rate of organic matter degradation following inoculation with DMC and PGPR biofortification. Upon addition of PGPR, microbial biomass carbon (MBC) attained a range of higher values in between 210.66-1167.21  $\mu\text{g g}^{-1}$  in MSW I and 201.46-1005.6  $\mu\text{g g}^{-1}$  in MSW II. Overall gradual drop of basal respiration rate and increment in microbial quotient was observed after addition of PGPR to MSW compost. A pot culture experiment was designed to check the efficacy of test plant Soyabean which exhibited that the MSW compost produced was non-toxic and displayed significant difference between the DMC treated plants over the uninoculated control. Study revealed that microbial mediators (DMC and PGPR) used during composting are efficient and can result in better bioconversion of MSW to usable compost.

# **Synthesis, characterization and release of nano-enabled phosphorus fertilizer in acid soils of Assam**

*Sukanya Pachani*

The study on “Synthesis, characterization and release of nano-enabled phosphorus fertilizer in acid soils of Assam” was undertaken during 2019-21 with the aim to synthesize and characterize zeolite based nano P fertilizer and to study its release pattern over 90 days of incubation in three different types of soil representing major soil orders of Assam, taking recommended fertilizer dose applicable for maize. Surfactant modification of the zeolite (SMZ) was done by using hexadecyltrimethylammonium bromide (HDTMABr) as surfactant and subsequently, the slow-release fertilizer (SRF) for phosphorus was synthesized by treating the SMZ with potassium dihydrogen orthophosphate to prepare the P-loaded SRF. It was observed from the XRD pattern that the zeolite framework had not undergone major structural change by the addition of HDTMABr and the crystallinity of zeolite remained the same. The surface morphology characterized by SEM, showed that the zeolite was of cubical geometry. The developed zeolite based nano P fertilizer recorded an average particle size of < 100 nm. The specific surface area of nano zeolite fertilizer (modified) was found to be less (90.07 m<sup>2</sup> /g) as compared to unmodified zeolite (262.72 m<sup>2</sup> /g). The pore diameter was found to be in the microporous (< 20 nm) range. Maximum adsorption of 7.4% added P was found in nanofertilizer which was 60% higher as compared to unmodified zeolite. The incubation study of P release in different treatments over the different types of soil witnessed marked variations during the entire days of incubation. Although no definite trend was observed in absolute control all throughout the incubation period, the lowest concentration of P was found in 7 days of incubation in all the treatments. In treatment receiving recommended dose of P through SSP, there was a gradual rise in available P concentration, reaching the maximum peak at 32 days of incubation beyond which no further increasing trend was observed. Relatively, the treatment receiving recommended dose of P through nano-fertilizer had a gradual increase of P from 7 days upto 90 days of incubation. A similar trend was also observed in nano treated P fertilizer receiving 2.5 times reduction, 5 times reduction, and 10 times reduction from the recommended

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dose. However, the concentration of release was lower and found to be in decreasing order as compared to recommended P level applied through nano P. Highest concentration of P at 90 days of incubation was found in recommended P applied through nano-fertilizer in the silty clay loam soil (8.82 mg/kg), which was significantly higher than recommended P applied through SSP (7.54 mg/kg). A significant difference was also noticed between recommended dose of phosphorus applied through nano P (8.82 mg/kg) and treatment receiving 2.5 times reduction of recommended P from nano P (6.38 mg/kg). The same trend of P release was observed in the soil with clay loam and sandy clay loam texture. 2 The differences in clay content between the soils affected the P release pattern which followed the order - Majuli (sandy clay loam) > Jorhat (silty clay loam) > Titabar (clay loam). The first-order kinetic constant was found to increase from 0.096  $\mu\text{g/g/day}$  in recommended dose of P applied through SSP to 0.100  $\mu\text{g/g/day}$  in treatment having a 10 times reduction of recommended P given through nano P in the silty clay loam soil. In the case of second-order kinetics, there was a decrease in rate constant value (-0.015 to -0.014  $\text{g}/\mu\text{g/day}$ ) which means an increase in the release of P. The rate constant of parabolic diffusion equation was the highest in treatment receiving recommended dose of P through nano-fertilizer (3.012  $\mu\text{g/g/day}$ ) in the silty clay loam soil. This increase in rate constant was found in the clay loam and sandy clay loam soil also which indicated high reactivity of the fertilizer. As observed from the R<sup>2</sup> value, the parabolic diffusion equation was found to be the best fit for describing the P release as compared to the other two kinetic models.

## Screening of Bio-Resource For Preparation of Quality Organics

*Sukhvindar*

The study on the “Screening of bio-resource for preparation of quality organics” was undertaken during 2021-22 with the aim to formulate organics with high NPK content from locally available bio-resources. In this study, composting using different crop residues (such as rice stubbles and banana pseudo-stem) along with animal dung/excreta (such as cow dung, goat dung and poultry excreta) were attempted. The experiment was laid out in Completely Randomized Design with 2 main factors (viz., E0: without earthworm and E1: with earthworm), and 6 treatment combinations in the sub-factors replicating 3 times. The treatment combinations under the subfactors were – T1: Crop residues (CR i.e. Rice stubbles + Banana pseudo-stem @ 1:1 ratio), T2: CR + cow dung (1:1 ratio), T3: CR + goat dung (1:1 ratio), T4: CR + poultry excreta (1:1 ratio), T5: CR + cow dung + goat dung (2:1:1 ratio), T6: CR + cow dung + goat dung + poultry excreta (3:1:1:1 ratio, respectively). Results revealed distinct differences in compost qualities prepared from different organics with and without earthworm. The pH and electrical conductivity was increased with increasing the time of composting until maturity. Different carbon (C) fractions viz., water soluble C, labile C and non-labile C in all the composts from different crop residues decreased during composting up to maturity. Data revealed an increase in C fractions in the vermicomposts (compost with earthworm) over the composts (without earthworm). The total C content in the composts also decreased with the advancement of composting period until compost maturity (120 days) in each substrate. The total C varied from 25.08 – 36.65, 18.69 – 26.01, 14.80 – 19.28 and 14.80 – 17.93% at 30, 60, 90 and 120 days of composting period, respectively. There were distinct differences in concentration of N, P and K in the composts generated from different crop residues with and without earthworm. The NH<sub>4</sub> – -N contents were found to decrease in all the composts prepared with various organics, whereas NO<sub>3</sub> – -N contents were increased with the composting periods. Total N content in all the treatments was also increased with composting time. Significant increase in total N content was recorded in case of the composts with earthworm compared to the composts without earthworm. The highest total N content (1.4%) was observed in the compost prepared from crop residues + cow dung + goat dung (T5)

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which was at par with T6 (CR + cow dung + goat dung + poultry excreta), whereas the highest total P (2.05%) and total K content (4.09%) were recorded in the T4 and T6, respectively. There was a significant increase in secondary nutrient content in all the treatments with respect to the time of composting. The calcium (1.08%) and sulphur (0.47%) values were the highest in T4 (Crop residues + poultry excreta) followed by T6. The highest (0.46%) magnesium content in matured compost was recorded in T2 (Crop residues + cow dung). Vermicomposting significantly enhanced the secondary nutrient content in the finished product as compared to the composts without earthworm. The qualitative aspect of organics significantly influenced the micronutrient content in the matured composts. The iron, manganese, copper and boron content in the matured composts varied from 109.4-127.8, 124.7-145.4, 13.8-26.6 and 36.8-69.1 mg kg<sup>-1</sup>, respectively at 30, 60, 90 and 120 days of composting. The highest iron, manganese, copper and boron content was recorded in T4 (Crop residues + poultry excreta) followed by T6 (CR + cow dung + goat dung + poultry excreta). The compost prepared from the combinations of crop residues+ cow dung + goat dung + poultry excreta (T6) showed the highest zinc content (55.4 mg kg<sup>-1</sup>). The lowest content of micronutrient was recorded in T1 (Crop residue compost). Data revealed that the bacterial count was enhanced up to 60 days with increasing the composting time and then gradually decreased until maturity, whereas the fungal count was increasing significantly up to 90 days. Similarly, the microbial biomass C varied from 773.2 – 1103.3, 985.3 – 1503.0, 987.9 – 1515.4, and 927.1 – 1255.2  $\mu$  gm gm<sup>-1</sup> at 30, 60, 90 and 120 days of composting period, respectively. The dehydrogenase activity significantly increased in the middle stage (60 to 90 days) of composting. It varied from 724.5 to 1066.1 ug TPF g<sup>-1</sup> 24h<sup>-1</sup> at 60 days of composting and 779.6 to 1109.0 ug TPF g<sup>-1</sup> 24h<sup>-1</sup> at 90 days of composting. The FDA (Fluorescein diacetate) activity also followed the same trend. The phosphomonoesterase activity increased with increase in composting period up to 90 days and thereafter declined. The NH<sub>4</sub>:NO<sub>3</sub> ratio and C:N ratio narrows down (below 20 and 1, respectively) gradually as the composting progresses indicating compost maturity. In the present study, vermicompost showed the higher seed Germination Index (GI) over the composts without earthworm. The highest GI (119.6%) was recorded in case of the compost prepared from crop residues + cowdung (T2) with earthworm followed by T5 (113.3%). Pearson correlation between the GI and maturity indices of the composts indicated the positive correlations. Overall, the relative order of performance of manures in terms of compost quality was T6 (CR + cow dung + goat dung + poultry excreta) > T5 (CR + cow dung + goat dung) > T4 (CR + poultry excreta) > T3 (CR + goat dung) > T2 (CR + cow dung) > T1 (CR). The highest compost recovery was recorded in T4 Followed by T6 and the lowest in T1. However, the above inferences are based on one year investigation and thus, further studies are required for recommendations of the findings from this study.

## **Effect of P-Enriched Biochar on Properties of Acid Soil**

*Varanasi Surya Teja*

Biochar is a product obtained by thermal heating of organic material in partial or total absence of oxygen to produce a carbon based residue. Biochar derived from bamboo has higher mass fraction when compared to other biochars and has higher surface area and higher pore volume. Phosphorus (P) – the second most important plant nutrient; exploited from the Earth's crust as rock phosphate – is an essential reserve to ensure global food security as there is no alternative to P in agriculture. The importance of phosphorus stands out more than the other elements because rock phosphate is a nonrenewable resource and there is no substitute for phosphorus in plants. In acid soils, its solubility is reduced due to the reaction of P with Fe and Al oxides. Since the efficiency of phosphorous is less, other novel mechanisms to be deployed to increase the availability of phosphorus. In the recent years enrichment of major nutrients is becoming forerunning initiative to increase the efficiency of the fertilizers. It is hypothesized that when Biochar is enriched with Phosphorous fertilizer, it favours the slow release of the Phosphate and increase the efficiency of Phosphorous. The present experiment entitled "Effect of P-enriched biochar on properties of acid soil" was framed to characterize bamboo biochar, formulate P-enriched biochar and to know the impact of P-enriched biochar on soil acidity and P availability. Bamboo stalks were used as feed stalk for the preparation of biochar and was collected from a Biochar Production unit at Deithar, Karbi Anglong under Rain Forest Research Institute, Jorhat. The biochar was produced in a special type of Dome shaped Brick Kiln with a pyrolysis temperature of 350-450°C. The enrichment of biochar was done in two different methods viz., Hot and Cold and enriched in five different ratios (F1=100:0, F2=75:25, F3=50:50, F4=25:75 and F5=0:100). The biochar was characterized for physico-chemical properties. The biochar was highly alkaline with pH 9.38 and high pore volume of 2.51 cm<sup>3</sup> g<sup>-1</sup> and porosity of 57.34%. The Iodine adsorption number was found to be 0.11596 M mL g<sup>-1</sup>. The average particle size of the biochar was 1.638 mm x 0.183 mm. The incubation study was carried out over 90 days in three soil types viz., Entisol, Inceptisol and Alfisol. The P-enriched biochar was applied @ 0.4% to the soil and soil was sampled at 0, 15, 30, 60 and 90 days of incubation. Increase in soil pH was observed over days of

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incubation from 6.28 to 7.86, 5.48 to 7.06, and 4.96 to 6.54 in Entisol, Inceptisol and Alfisol, respectively upon sole addition of biochar (Biochar:DAP=100:0) and the best formulation was found to be F1 (100:0) in all the soil types. Percent Soil organic carbon significantly increased over days of incubation from 0.75 % to 1.11 %, 0.96 % to 1.32 % and 1.24% to 1.60 % in Entisol, Inceptisol and Alfisol, respectively and F1 (Biochar:DAP=100:0) formulation has proved to be the best amongst other formulations. The cation exchange capacity of the soil increased over days of incubation from 6.10 to 14.18, 8.70 to 12.43 and 9.80 to 17.96 [cmol(p<sup>+</sup>) kg<sup>-1</sup>] in Entisol, Inceptisol and Alfisol, respectively upon sole addition of biochar in formulation F1 (Biochar :DAP=100:0). The Available Nitrogen increased over days of incubation from 271.30 to 349.85 to 376.10 and 297.40 to 375.95 kg ha<sup>-1</sup> in Entisol, Inceptisol and Alfisol, respectively. The best formulation where the available nitrogen was found to be the high is F3 in all the soil orders. Available Phosphorous increased over days of incubation from 14.50 to 22.33, 15.10 to 23.63 and 18.60 to 27.10 kg ha<sup>-1</sup> in Entisol, Inceptisol and Alfisol, respectively. In all soil orders, F3 (Biochar:DAP= 50:50) was found to be the best in increasing the P availability. Increase in available K (kg ha<sup>-1</sup>) was observed over days of incubation from 93.07 to 122.02, 98.6 to 126.82 and 109.30 to 138.27 upon sole application of biochar F1 (Biochar: DAP= 100:0) in Entisol, Inceptisol and Alfisol, respectively. Exchangeable Aluminium significantly decreased over days of incubation from 1.14 to 0.92, 1.62 to 1.26 and 2.18 to 1.71 [cmol(p<sup>+</sup>) kg<sup>-1</sup>] in Entisol, Inceptisol and Alfisol, respectively and the best formulation was found out to be F1 (Biochar:DAP=100:0). The exchange acidity of the soil decreased over days of incubation from 1.96 to 1.40, 2.56 to 1.98 and 2.86 to 2.27 [cmol(p<sup>+</sup>) kg<sup>-1</sup>] in Entisol, Inceptisol and Alfisol, respectively and the best formulation was found out to be F1 (Biochar:DAP=100:0). No significant decrease was observed in other acidity parameters like total acidity, total potential acidity, extractable acidity and pH dependant acidity Thus enrichment of bamboo biochar with phosphorous helps in increasing the availability of both N and P and has the potential to correct soil acidity as reflected by the increase in soil pH, decrease in exchangeable Al as well as exchange acidity and hence could be used as replacement of general liming material. The hot method of enrichment was found valid only for Alfisols in increasing N availability, whereas it was found significant in increasing the P-availability in all the soil orders. Since the cation exchange capacity, Specific Surface Area are more for bamboo biochar, it can be used for light textured soils so as to increase the adsorption of nutrients.

## **Studies on non-chemical methods for management of tea pests and use of plant based formulations against red spider mite**

*Bidisha Hazarika*

An investigation entitled “Studies on non-chemical methods for management of tea pests and use of plant based formulations against red spider mite” was carried out in the Experimental Garden for Plantation Crops (EGPC) and Department of Entomology, Assam Agricultural University, Jorhat during 2019-2021. The study was undertaken to survey non-chemical methods of management of red spider mite used by twenty small tea growers of Dibrugarh district of Assam and to study the efficacy of plant based formulations for management of red spider mite in-vitro. It was found that 45% of the small tea growers used cow urine with Ghora neem (*Melia azedarach*), Karanj (*Pongamia glabra*) and Pothorua bihlongoni *Polygonum hydropiper* combinations for management of red spider mite. Moreover, they also used bhoot jolokia (*Capsicum chinense*), sour curd, wheat flour in small quantities. In laboratory *Melia azedarach*, *Pongamia glabra* extracts were prepared at 2.5%, 5%, 7.5% concentrations alone or in combination with cow urine (5%) for use in the experiment. Among all the plant based formulations *Melia azedarach* (7.5%) + Cow urine (5%) was found to be the most effective formulation in-vitro for management of red spider mite. *Melia azedarach* (5%), *Melia azedarach* (5%)+ Cow urine (5%), *Melia azedarach* (7.5%), *Melia azedarach* (7.5%)+ Cow urine (5%) were found to be effective in reducing rate of oviposition of red spider mite which was at par with commercial neem formulation (1:1500). Egg hatchability was found to be reduced satisfactorily when the tea leaves were sprayed with *Melia azedarach* (7.5%), *Melia azedarach* (7.5%)+ Cow urine (5%) and were at par with commercial neem formulation. *Melia azedarach* (5%), *Melia azedarach* (5%)+ Cow urine (5%), *Melia azedarach* (7.5%), *Melia azedarach* (7.5%)+ Cow urine (5%) were found to be effective for mortality of nymphs of red spider mite which was at par with commercial neem formulation. Adult mortality was found to be at par with commercial neem formulations when the the tea leaves were sprayed with *Melia azedarach* (5%), *Melia azedarach* (5%) + Cow urine (5%), *Melia azedarach* (7.5%), *Melia azedarach*

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(7.5%)+ Cow urine (5%). The present investigation exhibited the possibility of using botanicals alone or in combination with cow urine for management of tea pests. It can be concluded that the non-chemical methods which are prevalent among the growers if scanned, validated and standardized scientifically would definitely help in the management of tea pests.

# **Morpho-physiological and biochemical characterization of tea [*Camellia sinensis* (L) O. Kuntze] germplasm maintained in the field gene bank of AAU**

*Bidisha Narah*

Tea is one of the oldest non- alcoholic bevaragesin the world which require proper observation, evaluation and documentation of germplasm to develop planting material of diverse genetic background. Germplasm collection helps in discovering archetypes which help in sorting out the taxonomy of tea. Accordingly this study was made to evaluate the morpho-physiological variability and to analyse the biochemical variability of unidentified tea germplasm in field gene bank maintained in the Experimental Garden for Plantation Crops. For which thirty germplasms were selected under the study. The germplasms THT 027, THT 028, THT 040, THT 041, THT 042, THT 043, THT 044 and THT 045 were found to have multiple stems which were similar to standard China type. Moreover they possessed purple colored young shoots, leaf upper surface was found to be “rugose”, ovate type leaf and erect leaf pose which were similar with typical China type, whereas the germplasms THT 021, THT 022, THT 024, THT 026, THT 030, THT 032, THT 033, THT 034, THT 035, THT 038 , THT 039, THT 048, THT 049 and THT 050 were found to have green color young shoot, glossy leaves, lanceolate type to oblong type of leaf shape and semi-erect to horizontal leaf pose similar with typical Assam type and Cambod type. In all the germplasm stem pigmentation was found to be indiscriminate. The germplasms THT 029, THT 033, THT 040, THT 041, THT042, THT 043, THT 044 and THT 045 exhibited densely distributed pubescence which is an important character for cup quality. The germplasms THT 021, THT 022, THT 023, THT 046 and THT 047 exhibited sparsely distributed young shoot pubescence while the remaining were observed to have medium young shoot pubescence. Soil Plant Analysis Detector (SPAD) study revealed that the germplasms THT 027 (49.4), THT 040 (47.2), THT 044 (44.7) showed the high SPAD value and the lower value was found for germplasms THT 041 (25.7) and THT

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042(25.9). The Relative Water Content(RWC) was recorded high in the germplasms THT 029(88.5%), THT 030(88.8%), THT 031(87.6%) whereas lower RWC was found in the germplasms THT 021(77.5%), THT 049(77.6%) and THT 050(77.8%). The highest polyphenol content was found in the germplasm THT 049 and lowest was found for THT 039. Germplasm THT 021 had the highest caffeine content of 4.1 % and lowest in THT 040 of 2.0 %. Moreover in case of total flavanoid all the germplasms exhibiting China type characters possessed high flavanoid.

## **Studies on non-chemical methods for management of tea pests and use of oil based formulations against red spider mite**

*Joyshree Konwar*

An investigation entitled “Studies on non-chemical methods for management of tea pests and use of oil based formulations against red spider mite” was carried out in the Experimental Garden for Plantation Crops (EGPC) and Department of Entomology, Assam Agricultural University, Jorhat during 2019-2021. The study was undertaken to survey non-chemical methods of management of red spider mite used by twenty (20) small tea growers of Sivasagar district of Assam and to study the efficacy of oil based formulations for management of red spider mite in-vitro. It was found in the survey that 50% of the tea growers used cow urine and water with Neem (*Azadirachta indica*), *Pothorua bihlongoni* (*Polygonum hydropiper*) and Karanj (*Pongamia pinnata*) combinations for management of red spider mite. Twenty percent (20%) of the tea growers used cow urine and water alone. Oil cake, cow dung, bhoot jolokia (*Capsicum chinense*), garlic (*Allium sativum*), limestone, curd and other ingredients were also used in small quantities. Home-made mustard and sesame oil were taken for laboratory experimentation on red spider mite, *Oligonychus coffeae* at 0.5%, 0.75% and 1% concentration alone or in combination with cow urine. Among the oil based treatment combinations, sesame oil 1% + cow urine 5% was found to be most effective for management of red spider mite. All the treatments of sesame oil were found to be effective in reducing rate of oviposition of red spider mite which were at par with commercial neem (1:1500). Egg hatchability was found to be reduced satisfactorily when the tea leaves were sprayed with sesame oil 1% and sesame oil 1% + cow urine 5% and were at par with commercial neem. Sesame oil 0.75% + cow urine 5%, sesame oil 1% and sesame oil 1% + cow urine 5% were found to be effective for mortality of nymphs of red spider mite which were at par with commercial neem. Adult mortality was found to be at par with commercial neem when sprayed with sesame oil 0.75%, sesame oil 0.75% + cow urine 5%, sesame oil 1% and sesame oil 1% + cow urine 5%. From the present study, it can be concluded that the nonchemical methods which are

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prevalent among the tea growers if scanned, validated and standardized scientifically would definitely help in the management of tea pests. These pest control practices serve as an alternative to overcome the ill effects of synthetic chemical pesticides. Thus, studies on oil based formulations mixed with cow urine or without cow urine showed possible incorporation and utilization in tea IPM programme.

## **Master of Fishery Science**

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- **Aquaculture**
- **Aquatic Environment Management (AEM)**
  - **Fish Processing Technology (FPT)**
- **Fisherise Respurce Management (FRM)**



# **Effect of Diet on Growth, Haematology and Disease Resistance of Amur Carp (*Cyprinus carpio haematopterus*) Through Replacement of Rice Polish With Rice Beer Waste**

*Astrica Phukan*

The objective of the research work was to determine the effect of feeding rate on growth performance such as specific growth rate, feed conversion ratio and protein efficiency ratio as well as haematological responses, such as RBC, WBC, Hb, Hct, MCV and MCHC and disease resistance of Amur carp (*Cyprinus carpio haematopterus*) against *Aeromonas hydrophila*. The experiment was conducted in cement cisterns with a water level of 80±5 cm for 120th days. Four different treatments viz. T-0, T-1, T-2 and T-3 were used in triplicates with 0%, 15%, 30% and 40% incorporation of rice beer waste respectively. Each tank (5.5m × 4m × 1m) was stocked with 100 numbers of Amur carp fingerlings and were fed twice a day with pelleted diet. A fortnight interval physico-chemical parameters of water and growth of experimental fish were recorded and evaluated. In this study, Amur carp growth was significantly ( $p < 0.05$ ) higher in treatment T-3, which had 40% inclusion level of rice beer waste. Control with 0% inclusion of rice beer waste showed lowest growth of fish. The SGR (3.30 g), FCR (1.85) and PER (4.31) value showed comparatively better in T-3 treatment. Haematological parameters in different treatments were evaluated after the end of the experiment where treatment T-1 had the highest RBC count (3.20 million/mm<sup>3</sup>) and was significantly ( $p < 0.05$ ) different from all other treatments (T-2 and T-3). The maximum WBC count (13.30 thousands/mm<sup>3</sup>) was recorded in T-3, and the lowest (11.40 thousands/mm<sup>3</sup>) was found in T-1. The highest level of haemoglobin (7.93 g/dl) and hematocrit (27.38%) was found in treatment T-1, which had 15% inclusion rate of rice beer waste and was significantly ( $p < 0.05$ ) different from the other treatments. MCV value was found to be highest (133.67 fl) in control (0%) and highest value of MCHC (28.96 g/dl) showed in T-1 (15%), while the lowest MCHC was (26.57 g/dl) in T-2 (30%). At the end of the experiment, 120<sup>th</sup> days of experiment Amur carps were

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challenged with *A. hydrophila* at different dosages ( $10^{-2}$  to  $10^{-9}$  CFU/ml) to determine the mean lethal dose (LD<sub>50</sub>), which was calculated as  $10^{-7}$  CFU/ml. The fishes were challenged with the dose of *A. hydrophila* ( $2.53 \times 10^7$  CFU/ml) and RPS (Relative percentage survival) was calculated upto 10 days. The RPS value (51%) was the highest in treatment T-3. The present findings clearly indicated that incorporation with rice beer waste-supplemented diets not only influence fish growth but also interfere with hematological parameters and immunological response in Amur carp by enhancing non-specific defense mechanism in fish.

# **Effect of stocking densities on growth performance and survivability of Amur Carp (*Cyprinus carpiohaematopterus*) in floating cage environment of a floodplain wetland of Morigaon District**

*Homen Saikia*

An experiment was conducted for a period of three months from October to December, 2020 at *Jaluguti beel*, District-Morigaon, Assam to determine the optimum stocking density of Amur Carp (fry of genetically improved common carp) reared in 12 nos of floating cages of size 48m<sup>3</sup> (6m x 4m x 2m), where 15 fishm<sup>-3</sup>, 20 fish m<sup>-3</sup>, 25 fish m<sup>-3</sup> and 30 fish m<sup>-3</sup> were set as the different stocking densities designated in treatment (T<sub>1</sub>),(T<sub>2</sub>),(T<sub>3</sub>) and (T<sub>4</sub>) respectively in triplicates. The mean initial length and mean initial weight of the fry used in the experiment were 1.90±0.05cm, 1.96±0.03cm, 1.90±0.05cm, 1.90±0.05cm and 0.17±0.01g,0.18±0.01g, 0.17±0.01g and 0.17±0.01g for treatment (T<sub>1</sub>),(T<sub>2</sub>),(T<sub>3</sub>) and (T<sub>4</sub>) respectively. Whereas, the mean harvesting length and weight in treatment (T<sub>1</sub>),(T<sub>2</sub>),(T<sub>3</sub>) and (T<sub>4</sub>) recorded were 14.96±0.03cm, 14.66±0.03cm, 13.96±0.03cm, 13.36±0.03cm and 53.03±0.01g, 42.79±0.14g, 33.20±0.10g,29.31±0.10g respectively. After three months of rearing, final length and weight gain was found to be highest at lowest stocking density treatment (T<sub>1</sub>) and lowest at the highest stocking density treatment (T<sub>4</sub>) with significance differences among the treatments (p<0.05). Further, specific growth rate (SGR) and survivability % were found to be the highest at lowest stocking density (T<sub>1</sub>) and lowest at the highest stocking density (T<sub>4</sub>) with significant differences (p<0.05) among the treatments. Feed conversion ratio (FCR) values were adversely affected with the increase in stocking density. FCR value was found to be the lowest as 1.74±0.03 in (T<sub>1</sub>) and highest in (T<sub>4</sub>) as 2.11±0.01. The concentration of Ammonia-nitrogen recorded under present study showed that it had an adverse impact on the fish growth. Ammonia concentration was found to be increased due to increased stocking density from (T<sub>1</sub>)to (T<sub>4</sub>) @ of 15m<sup>-3</sup> to 30m<sup>-3</sup>. The other water quality parameters recorded in the different treatments did not vary significantly and

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was almost in the acceptable range conducive for fish culture. Hence it can be assumed that due to higher stocking density there was an increase in Ammonia concentration which might be the reason for the reduction in growth of fish in (T<sub>4</sub>). The gross yield  $39.41 \pm 0.02$  kg and benefit cost ratio (1.73) were found to be the highest in (T<sub>2</sub>) among all the treatments. Thus, economics of operation was considered to be most important criteria in deciding the optimal stocking density for raising Amur Carp fry in cages in a seasonally open beels of Assam having similar ecological characteristics like *Jaluguti* beel.

## **Experimental Breeding Of *Channa Striatus* (Bloch,1793) Using Different Hormones under the Agro-Climatic Condition of Assam**

*Rikki Bagra*

An experiment on induced breeding of *Channa striatus* in captivity using two different GnRH based synthetic hormones viz., Gonopro-FH and Ovafish and was injected intramuscularly. The experiment was conducted following a Completely Randomized Design (CRD). This study consists of three treatments i.e., low dose (0.2 and 0.4 ml/kg), medium dose (0.4 and 0.6 ml/kg), high dose (0.6 and 0.8 ml/kg) each dose with three replications for both the hormones. Brooders (2:1) male and female were injected with doses of 0.2 and 0.4, 0.4 and 0.6, 0.6 and 0.8 ml/kg body weight male and female respectively. All the doses induced the fish to breed. The efficacy of both the hormones was evaluated for the performance parameters such as spawning fecundity, fertilisation rate, hatching rate, latency period and incubation period were the highest ( $P < 0.05$ ) at medium dose (0.4-0.6 ml/kg). Outcomes of all the doses varied significantly with each other with the low doses of male female 0.2 and 0.4 ml/kg showed the least performance. Using Gonopro-FH more fecundity was achieved than compared to the Ovafish. Brooders injected with Ovafish has shown longer latency period of 23.73 to 27.73 hours and incubation period of 23.43 to 27.33 hours than the Gonopro-FH 21.46 to 25.46 hours and 22.5 to 25.33 hours respectively. With Gonopro-FH maximum fertilization rate was 88.68% and hatching rate was 86.06%, while for the Ovafish, fertilization rate was 87.09% and 79.43% of hatching rate was achieved. This study clearly shows that Gonopro-FH gave better results than the Ovafish in the captive breeding performance of *Channa striatus*.

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## **Effect of probiotic bacteria identified and characterized from gut of freshwater fish on growth performance of *Labeo rohita***

*Rubina Yasmin*

The present study was carried out to isolate, identify and characterize probiotic bacteria in the gut content of *Ctenopharyngodon idella* (Grass carp) and to study its effect on growth performance of *L. rohita* fingerlings by dietary administration for a period of 6 months. A total of 6 nos. of gram positive bacteria belonging to the genus, *Lactobacillus* spp. (3 nos.), *Bacillus* spp. (2 nos.) and *Staphylococcus* spp. (1 no.), were identified biochemically followed by molecular techniques. The identified isolates were subjected to pH tolerance test, antibiotic sensitivity test, antimicrobial activity assay and enzymatic activity assay. The pH tolerance test performed showed that all the isolates were able to survive at low pH of 4.0. The pH range of the *Lactobacillus* spp. in the present study was found to be 4.0 to 9.0. The antibiotic sensitivity test showed that the isolates were sensitive towards Penicillin G, Ampicillin and Novobiocin. The *Lactobacillus* spp. was more sensitive towards all the antibiotics. The antimicrobial properties of the isolated bacteria were tested against two common bacterial fish pathogens *A. hydrophilla* and *P. putida* which showed that the strains of *Lactobacillus* spp. had inhibitory effect against both the pathogens. Two identified strains of *Lactobacillus* spp. were selected to evaluate its effect on the growth parameters of *L. rohita* fingerlings by dietary administration. The results showed that the growth of *Labeo rohita* was significantly increased by administration of *Lactobacillus* spp. fed with 5 ml/kg of 10<sup>6</sup> cells/ml. The SGR% for *Labeo rohita* was found to be 0.796±0.013 and 0.733±0.006, the average net weight gain was 25.426±0.636 g and 21.629±0.106 g, the average net length increment was 11.453±0.243 cm and 10.089±0.169 cm respectively for T1 and T2 with significant difference among the treatments (p-value <0.05) when compared with the control. The results of the present study conclude that *Lactobacillus* spp. isolated from the gut content of *Ctenopharyngodon idella* (Grass carp) could be used as a potential probiotic to improve the growth of *L. rohita*. It also opens an arena to study the effect of single and conjoint *Lactobacillus* spp. in growth performance and immune response of fishes and its potential to be used in farmer's field on a commercial basis.

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## **Evaluation of Some Non-Conventional Animal Protein Sources in the Practical Diet Formulation of Fresh Water Cat Fish *Clarias magur* and Its Effect on Growth and Biochemical Composition**

*Shah Mustahid Hussain*

The present investigation was carried out to evaluate the growth performance of *Clarias magur* in response to different nonconventional diets, in the two locations Raha of Assam and Pasighat of Arunachal Pradesh. Juvenile magur weighing average  $8.49 \pm 1.98$  g and  $15.83 \pm 4.83$  g (Raha and Pasighat) were reared in tanks maintaining water level at  $50 \pm 5$  cm with six inches of soil bed. The fish were stocked @ 4 no./m<sup>2</sup> and fed with four iso-nitrogenous (35% crude protein) experimental diets D-1 (Vermi meal), D-2 (Chicken viscera meal), D-3 (Vermi meal+ Chicken viscera meal) and D-4 (Fish meal) @ 5 to 10 % of body weight in two split doses daily in the morning and evening. The diet D-4 was considered as reference diet. The experimental diets were prepared by using ingredients such as Fish meal, Vermi meal, Chicken viscera meal, Rice polish, Wheat flour & Vitamin and mineral mixture at different combination.

The result reflected that the growth performance observed after six months of rearing the fish fed with Fish meal based diet was the best (204.93 g Raha; 194.54 g Pasighat), followed by 100% replacement of Fish Meal with Chicken viscera Meal (200.81 g Raha; 192.61 g Pasighat); Fish meal with mixture of Vermi meal and Chicken viscera meal (190.32 g Raha; 179.69 g Pasighat); and Fish meal with Vermi meal (181.30 g Raha; 174.58 g Pasighat). The present findings reflected that 100 % replacement of Fish meal can be done with Chicken viscera and mixture of Vermi meal and Chicken viscera meal without affecting the growth performance of the fish and flesh quality as differences in growth performance are almost negligible.

The feed conversion ratio ranges between 1.50 to 1.75 for the fish grown on Fish meal based diet and 1.54 to 1.77 for Chicken viscera based meal diet and 1.62 and 1.91 for mixture of Chicken viscera meal and Vermi meal diet. All the experimental diets contains almost all the essential amino acids, however glycine and glutamic acid content

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was higher with all the experimental diets (glycine: 1.71-2.31 g/100g feed; glutamic acid: 5.41-5.95 g/100g feed). The digestibility of protein and lipid in diets D-4 and diet D-2 (Chicken viscera meal based diet) were not significantly different ( $P>0.05$ ). The protein digestibility was highest ( $78.89 \pm 1.43$  %) with the reference diet D-4; while among the experimental diets, the protein digestibility was better with the diet D-2 ( $76.21 \pm 0.81$  %) followed by diet D-3 ( $75.89 \pm 2.05$  %) and diet D-1 ( $73.72 \pm 1.67$  %). The protein digestibility values did not vary significantly ( $P>0.05$ ) among the treatments. The Moisture, Dry matter, NFE, Ash, Fibre and Protein percentage in muscles of the fishes grown with four different diets were not significantly ( $P>0.05$ ) different, but lipid % were significantly ( $P<0.05$ ) different for different diets for both the location. Significantly high ( $P<0.05$ ) muscle lipid content was observed in the fish fed with diet D-2 followed by diet D-3 (mixture of Vermi Meal and Chicken Viscera meal based diet), diet D-4 and diet D-1. While assessing the consumer preference by Hedonic scale method it was found that all the fishes grown on different diet treatments was equally preferred. The present study indicated that nonconventional animal protein sources like vermi meal and chicken viscera meal are acceptable ingredients for the replacement of fish meal in practical diets of *Clarias magur*. The magur growers of North Eastern Region of India can use the formulation for preparing of feed for the fish as the ingredients used in the present study are largely available due to higher consumption of chicken in human diet as well as the approaches given for organic farming resulting in wide vermiculture practices in the region. Further, the use of chicken viscera in feed will minimize the environment pollutions converting the waste wealth.



## **Study of Productivity and Ichthyofaunal Diversity of Kharungpat Lake, Manipur**

*Abdul Salam*

The present investigation was undertaken during the period 2019-2021 to study the productivity and ichthyofaunal diversity of Kharungpat lake located towards the southern lowlands of the central valley of Manipur (India). The lake water was characterized by moderate temperature (16.68-29.21 oC), fluctuating transparency (53.00-119.30 cm), suitable level of pH (6.26-7.74) and dissolved oxygen (5.10–9.35 mg/l), favourable total alkalinity (31.21-66.29 mg/l), total hardness with a value of 28.37-66.49 mg/l which can sustain low growth of fish, fluctuating level of free carbon dioxide (3.78-10.23 mg/l), phosphate phosphorus and nitrate nitrogen content with a value ranged from 0.001 to 0.018 mg/l and 0.01-0.30 mg/l. Sediment pH (4.00-6.20) of the lake exhibit acidic and low productive and it is not conducive for good growth of fish and microbial activity, moderate organic carbon (1.00-2.64%) and high organic matter (1.72-4.55%) was recorded. The recorded available nitrogen (7.36 to 28.42 mg/100g) and phosphorus level of sediment (0.29 to 1.15 mg/l) indicates low productive nature of the lake while the available potassium level (21.72-49.84 mg/100mg) were observed to be very poor from fishery point of view. Variation in sediment quality and physico-chemical characteristic of water was influence by temperature, rainfall and biotic communities. An average plankton population ranged between 141 to 1413 units per liter indicated low productive of the lake. Chlorophyceae, Cyanophyceae, Bacillariophyceae and Euglenophyceae are the four major phytoplankton groups identified with a percentage composition of 51.79%, 31.00%, 13.12% and 4.33% respectively. Cladocera, Copepoda and Rotifera are the three major zooplankton groups identified comprising of 16 genera under 13 families and 8 orders. The gross and net primary productivity of the lake Kharungpat ranged between 55.80 to 259.35 mg C/m<sup>3</sup>/hr and 12.22 to 103.19 mg C/m<sup>3</sup>/hr respectively. The gross primary productivity indicated the low productive nature of the lake. A total of 26 aquatic macrophytes were identified comprised of 26 species belonging to 23 genera, 15 families and 11 orders. The luxuriant growth of aquatic macrophytes in lake indicates that the lake is eutrophic in nature. The fish diversity of Kharungpat lake comprised of 29 species belonging to 20 genera, 11 families and 6 orders in which Cypriniformes formed one of the most

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dominant order as compared to all other orders recorded comprising of 52% of the total fish species of the lake. Out of the total 29 fish species identified, 5 species are exotic and 24 species are recorded to be indigenous. The 5 exotic species are *Ctenopharyngodon idella* (0.38%), *Cyprinus carpio* (0.58%), *Cyprinus vili carpio specularis* (0.71%), *Hypophthalmichthys molitrix* (0.75%) and *Oreochromis mossambicus* (6.00%). Shannon and Margalef richness indicated less healthy environment of the lake.

The fish diversity indicated that the fish population of the lake could be enhanced by supplementary stocking with *Labeo catla*, *Labeo rohita*, *Cirrhinus mrigala*, *Labeo Calbasu*, *Labeo goniis*, *Labeo bata* with the introduction of indigenous fish like *Osteobrama belangeri* coupled with the introduction of *Ctenopharyngodon idella* is expected to augment fish yield. Clearance of aquatic macrophytes in the lake is likely to change its ecological structure to a plankton-based system, making it potentially more productive ecosystem. Monitoring of encroachment of lake catchment area, regular awareness programme on proper and judicious use of resource, protection of lake ecosystem by full participation of local community could improve the lake environment.

## **Acute Toxicity Study of Silica Nanoparticles (SiO<sub>2</sub>-NPs) on *Cyprinus carpio* (Linnaeus, 1758)**

*Habiba Jahan Ahmed*

Silica nanoparticles (SiO<sub>2</sub>-NPs) are among the most widely used nanoparticles (NPs) in a variety of fields including medicines, consumer goods, biotechnological applications etc. Although studies on the toxicity of SiO<sub>2</sub>-NPs to human and mammalian cells have been published, the effects of SiO<sub>2</sub>-NPs on fish remain unknown. Therefore, the present study was intended to evaluate the acute toxicity, behavioural and hematological alterations in *Cyprinus carpio* (common carp) exposed to SiO<sub>2</sub>-NPs. The median lethal concentration (LC<sub>50</sub>) values were found to be 12553.05 mg l<sup>-1</sup>, 9142.07 mg l<sup>-1</sup>, 6637.24 mg l<sup>-1</sup> and 4479.11 mg l<sup>-1</sup> for 24 hour, 48 hour, 72 hour and 96 hour respectively, indicating SiO<sub>2</sub>-NPs to be relatively harmless. When exposed to lethal (96 hour LC<sub>50</sub>) concentration of SiO<sub>2</sub>-NPs, the fishes showed alterations in behaviour as well as hematological parameters. Behavioural changes such as abnormal opercular movement, imbalance swimming, hyperactivity, loss of buoyancy, lethargy, excess mucus secretion and fading of skin colour. were observed during 96 hour of exposure. Hematological parameters like hemoglobin (Hb), packed cell volume (PCV) and total erythrocyte count (TEC) decreased with respect to control, while total leucocyte count (TLC) values increased initially and then decreased. The hematological indices such as mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) decreased while mean corpuscular hemoglobin concentration (MCHC) values increased with time in the present investigation. All the values were significantly different (p<0.05) during different exposure period except for MCHC values which did not exhibit any statistical difference (p>0.05). Overall, this report can be used in extending future research using fish as a model to assess the toxicity of SiO<sub>2</sub>-NPs to aquatic organisms.

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# ***In Vivo* Evaluation of Toxicity effects of a Neonicotinoid Insecticide Imidacloprid on Freshwater Cypriniform *Cyprinus carpio* var. *communis***

***Hemanta Pokhrel***

Imidacloprid (IMI) is a systemic insecticide belonging to the class of neuro active chemicals called the neonicotinoids, used for the control of pest and insects in agricultural crops. IMI was reported to be highly toxic to bees, humans and non-targeted aquatic animals. Therefore, the aim of the present study was to evaluate the toxicity effects of commercial-grade Imidacloprid (Premise, 30.50%, SC) to standard non targeted test organism, *Cyprinus carpio* var. *communis* (Common carp) using biological endpoints like histological analysis, haematological parameters, serum biochemical analysis, antioxidant responses, neurotoxicity (Acetylcholinesterase activity), genotoxicity (Micronucleus test) and gene expression study. The current study reveals that 96hr LC<sub>50</sub> value of commercially available Imidacloprid was 208.38 mg/l (173.66 - 262.37) with 95% confidence interval. Effect of 96hr LC<sub>50</sub> concentration was determined by exposing test fish to above said concentration under laboratory static renewal test and analysis was carried out on every 24, 48, 72, and 96hr, whereas for 28 days chronic exposure semi static renewal test was deployed with 3 sub lethal concentrations LC<sub>50</sub>/8 (T<sub>1</sub>= 26.04 mg/l), LC<sub>50</sub>/10 (T<sub>2</sub>=20.83 mg/l,) and LC<sub>50</sub>/12 (T<sub>3</sub>=17.36 mg/l) which were selected based on the calculated 96hr LC<sub>50</sub> value and analysis was carried on 7<sup>th</sup>, 14<sup>th</sup>, 21<sup>st</sup> and 28<sup>th</sup> day. Behavioural alterations like jumping movement, restlessness, hyperventilation, hyperactivity, gulping, coughing and corkscrew swimming at surface and bottom of the tank were observed. Enhanced mucus secretion, loss of buoyancy and string of faeces hanging from anus or on the tank was also observed during acute exposure to 96hr LC<sub>50</sub> concentration for 24, 48, 72, and 96 hrs. Marked histological alterations in liver like exocrine pancreatic acini, hepatic degeneration and mononuclear infiltration were observed; in gills epithelial lifting, oedema, telangiectasis in secondary lamellae, lamellar fusion while in kidney expansion of Bowman's space, cloudy swelling of epithelial cells, necrosis of several renal tubules

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and multiple focal areas of inter-tubular haemorrhage were observed during both acute and chronic exposure. Results showed that immune- haematological parameters like haemoglobin (Hb), packed cell volume (PVC), red blood cells (RBC), white blood cells (WBC), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), Nitroblue tetrazolium bursts activity (NBT), lysozyme activity (LA) altered significantly ( $*p<0.05$ ) during both acute and chronic exposure. Serum biochemical parameters like Glucose, Cholesterol, Phospholipid, Triglyceride, HDL, VLDL, Magnesium, AST, ALT increased significantly whereas protein, albumin, globulin, A:G ratio, LDL significantly decreased during both acute and chronic exposure to IMI. Significant induction in oxidative stress enzymes (SOD, CAT, GPx, AST and ALT) and Oxidative stress biomarkers (ROS, MDA) in liver, gill and brain tissues were also observed during acute exposure, whereas in chronic exposure the same was observed in dose and time dependent manner. Significant reduction in brain AChE enzyme activity due to inhibition of acetylcholine esterase and DNA damage through significant induction of micronuclei formation in the erythrocyte of fish blood was clearly observed. Upregulation of HSP70 and CYP1A gene in both liver and gill tissues of exposed fish were observed on 7<sup>th</sup>, 14<sup>th</sup>, 21<sup>st</sup> and 28<sup>th</sup> day in dose and time dependent manner. Findings indicates that acute exposure of commercial-grade Imidacloprid (Premise, 30.50%, SC) induces immunotoxicity, neurotoxicity, oxidative stress, histological alterations and DNA damage, leading to the cause of death. Moreover, it is also observed that even at sublethal concentrations IMI can act as a potential immunosuppressor, oxidative stress enhancer and can trigger probable neurotoxic and genotoxic effects which may result in physiological imbalances leading to reduced growth. Our study also indicates that IMI is a moderately hazardous insecticide to non-target aquatic organisms and No Observed Effect Concentration (NOEC) of the product will be  $<17.36$  mg/l. Further study is required to determine the actual NOEC concentration of the product Premise (30.50% SC), thus warranting the product for further review of human health and environmental safety.

## **Effect of pH on Acute Toxicity of Synthetic Antioxidant Butylated Hydroxytoluene in Embryo of Zebrafish *Danio rerio* (Hamilton, 1822)**

*Nikimoni Borah*

BHT (3, 5-di-tert-butyl-4-hydroxytoluene) is a synthetic antioxidant which is used in food additive, cosmetics and plastic industries to increase the reliability of food and plastic. The production, use and release of these antioxidants can create contaminant source for aquatic ecosystem. Due to the global climate change temperature is increasing now a days and this increasing temperature impacts on water physicochemical parameters like dissolved oxygen level and pH, which could affect the toxicity of contaminants to aquatic organisms. Many toxins increase or decrease in toxicity due to water quality. The present study was undertaken to evaluate the effects of pH on toxicity of BHT in zebrafish (*Danio rerio*) embryo. Zebrafish embryos were exposed to five different level of pH (5, 6, 7, 8 and 9) with 6 different concentrations of BHT for 96 hour and lethal and developmental endpoints were assessed. LC50 values for 96 hour found in this study at pH 5 to 9 were 2.067 mg l<sup>-1</sup>, 2.453 mg l<sup>-1</sup>, 3.356mg l<sup>-1</sup>, 1.210mg l<sup>-1</sup> and 0.823mg l<sup>-1</sup> respectively. Developmental deformities observed in sub-lethal concentrations at pH 5 to 9 during 24, 48, 72 and 96 hour post fertilization were pericardial edema, yolk sac edema, deformed otolith, notochord deformation, accumulation of RBC and Spine deformities. In sub-lethal concentrations, heartbeat of zebrafish embryo increased at all pH and were significantly different (p<0.05) at pH 5, 8 and 9 when compared to control. Hence, the present study could be a best for future research using fish embryo as a model to determine the effect of other environmental parameters on acute toxicity of Butylated hydroxytoluene (BHT).

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# **Assessment of Acute Toxicity in Fresh Water Cypriniform *Cyprinus carpio* (Linnaeus, 1758) Exposed to a Commercial Neem based Biopesticide**

*Rituparna Borah*

Pesticides are the leading polluting agents of aquatic ecosystems. Pesticide residue in natural water bodies may affect indigenous ichthyofauna as well as human health. Azadirachtin, a pesticide derived from the neem tree (*Azadirachta indica*), is a highly effective and widely used pesticide. The present study investigated acute toxicity, behavioural and biochemical compounds in common carp (*Cyprinus carpio*) exposed to Azadirachtin. The acute toxicity test was performed according to the standard methods EPA (1996) and the 24, 48, 72 and 96 hours LC<sub>50</sub> values of Azadirachtin for *Cyprinus carpio* were estimated as 3.924 mg/l, 2.858 mg/l, 2.075 mg/l and 1.414 mg/l respectively. The study also recorded the behavioural changes that were observed during 24, 48, 72 and 96 hours of exposure period like hyper excitability, enhanced opercular movement, fin movement, enhanced mucus secretion, imbalanced swimming, loss of reflex, lethargy etc. Serum biochemical compound such as total serum protein, serum glucose and serum albumin were analyzed with 96 hours LC<sub>50</sub> value (1.414 mg/l) of Azadirachtin. Significant reduction in values was obtained for total serum protein and albumin while significant increase was observed in glucose. However, statistical significance ( $p < 0.05$ ) was observed during 24, 48, 72 and 96 hours for total serum protein, serum glucose and serum albumin.

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# **Acute Toxicity of Synthetic Pyrethroid Pesticide Cypermethrin in Developing Zebrafish (*Danio rerio*) (Hamilton-Buchanan, 1822) Embryo**

*Ruhul Amin*

Cypermethrin (CP) is a type II pyrethroid that is used to protect economically important crops such as cotton, fruits, and vegetables from a wide range of insects. Pyrethroid pesticides have been applied to agriculture and aquaculture since the 1970s to replace traditional pesticides. However, pyrethroids are approximately 1000 times more toxic to fish than to mammals and birds. In the present investigation, an attempt has been made to determine median lethal concentration ( $LC_{50}$ ), effective concentration ( $EC_{50}$ ) and Teratogenic Index of a 10% cypermethrin commercial formulation on developing zebrafish embryo. The 96-hour  $LC_{50}$  value was calculated as 0.129 ppm and  $EC_{50}$  value was found to be 0.028 ppm. The abnormalities like pericardial edema, yolk sac edema, tail deformity, decrease body, eye pigmentation and axial malformation (notochord bending) were observed in zebrafish embryo exposed to different concentrations of CP. The heartbeat and heart size changed significantly ( $P < 0.05$ ) at higher concentrations and exposure time. The Teratogenic Index (TI) was calculated to be 4.607 which implies that the compound may be a probable teratogen. As a result, the findings of this study show that cypermethrin can have a negative impact on the early developmental stages of zebrafish. The current study opens future scope for research on its acute as well as chronic effects.

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## **Effect of Garlic Extract on Quality of Dried *Puntius sophore* During Storage at Ambient Temperature**

*Ipsita Jamatia*

The present study was conducted for a period of six months to evaluate the effect of garlic extract on the proximate, biochemical, microbiological and organoleptic properties of dried *Puntius sophore* during the storage period. The garlic extract was used at the rate of 5%, 7% and 10% level. During the study it was found that the yield percentage of dried *P. sophore* was 23.26%. The results showed that there was no significant ( $P < 0.05$ ) effect in the moisture and ash content of the control and treated samples. The decrease of the protein, fat content during storage in treated sample with 10% garlic extract was significantly ( $P < 0.05$ ) less when compared to that of control. The protein, fat, moisture and ash of the treated sample with 10% garlic extract was in the range of 42.54% - 41.40%, 23.54% - 22.58%, 13.09% - 14.01% and 16.12% - 17.10% respectively during the storage period. The effect of garlic extract on the biochemical characteristics revealed that the PV, FFA and TVB-N content in 10% garlic extract was significantly ( $P < 0.05$ ) less when compared to that of control which ranged from 1.13 meq/100g - 1.49 meq/100g; 1.14% as oleic acid - 1.42% as oleic acid and 17.04 mg% - 22.64 mg% respectively during the storage of 180 days which were within the acceptable limits. The microbial characteristics also showed that the garlic extract (10%) have shown significantly ( $P < 0.05$ ) lower increase in counts during the storage period which was within the acceptable limits of  $< 10^6$  cfu/g. In case of organoleptic characteristics it was found to slightly decrease and was found that the odour and overall acceptability of 5% garlic extract treated samples were significantly ( $P < 0.05$ ) higher. Overall, it can be interpreted from the findings that as the concentration of garlic extract increases its effect on the proximate, biochemical and microbiological characteristics increases, however, considering the organoleptic parameters, treatment of *P. sophore* with 5% garlic extract have significant effect on the odour and overall acceptability of the product.

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## **Effect of Ginger Extract on Quality of Dried *Amblypharyngodon mola* During Storage at Ambient Temperature**

*Misan Debbarma*

The quality of traditionally prepared sun-dried fish is generally poor due to oxidation, microbial activities, chemical activities, insufficient drying and also selection of low-quality raw materials, fishes may have bad smell, bitter taste, changes in colour and many more which makes it unacceptable for the consumers. Considering the above mentioned problems, an attempt was made to study the effect of ginger extract as a preservative on proximate composition, biochemical compositions, microbiological quality and organoleptic properties of sun-dried *Amblypharyngodon mola* during storage at ambient temperature.

In the present study, a 180 days experiment was conducted and *Amblypharyngodon mola* was selected as a raw material. The purpose of the study was to produce chemicals free dry fish using natural preservative. Selected raw material was treated with ginger extract of 5%, 10% and 15% with 10 % salt and compared with control sample which is treated with only 10 % salt. Significant changes were noted in protein content, fat content, TBV-N content, PV content, FFA content and microbiological quality during storage period. But in case of moisture and ash there was not that much of difference. However, as the storage period increases, moisture and ash content increases in all the samples. Slightly higher crude protein and crude fat was noted in treated samples as compared to control sample. It was observed that protein and fat content decreases with storage period in all the samples. However, lower decreasing trend of both protein and fat content was noted in treated samples. In biochemical study, the values of TVB-N, FFA and PV increases with storage period. TVB-N value was found to be 19.14 mg% (C), 18.67 mg% (T1), 18.54 mg% (T2) and 17.97 mg% (T3) at the initial days of storage. At the end of storage period values of 24.50 mg% (C), 24.27 mg% (T1), 23.34 mg% (T2) and 20.77 mg% (T3) were noted. FFA values were found to be 1.31% (C), 1.22% (T1), 1.13% (T2) and 1.16% (T3) at the initial days of storage. At the end of storage period values of 2.98% (C), 2.81% (T1), 2.17% (T2) and 1.79% (T3)

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were noted. In case of peroxide value, it was found to be 2.90% (C), 2.51% (T1), 2.47% (T2) and 1.62% (T3) at the initial days of storage. At the end of storage period values of 3.66% (C), 3.29% (T1), 2.97% (T2) and 2.27% (T3) were noted.

Low bacterial load was noted in treated samples during storage period and the highest total plate count was recorded in control sample with count of 5.64 log cfu/g at the initial days of storage. At the end of storage period 6.23 log cfu/g was noted in control sample. The lowest bacterial load was observed in 15% concentration of ginger extract treated sample (T3) with count of 5.12 log cfu/g at the initial days of storage. At the end of storage period 5.70 log cfu/g was noted in T3 sample.

Based on sensory evaluation, ginger treated fish scored higher as compared to treated with only salt. Organoleptically, sample treated with ginger extract had the best acceptance as compared to control.

The use of salt and ginger (*Zingiber officinale*) together gives the best result as compared to the use of salt alone. Treated with salt and different ginger extract concentration was found to be more effective to minimize the biochemical and microbial activity. Therefore, ginger extract can be incorporated with salt to enhance the shelf-life of dried *Amblypharyngodon mola*.

# **Study on Ichthyofaunal Diversity and Physicochemical Parameters Downstream of Hydroelectric Power Project Dam of Subansiri River, Assam**

*Imran Hussain*

The present study on ichthyofaunal diversity and physico-chemical parameters downstream of Subansiri river, Lakhimpur district of Assam was conducted for a period of 1 year from April, 2020 to March, 2021. Altogether 55 fish species belonging to 42 genera, 24 families and 10 orders were recorded from the river. The largest group Cypriniformes contributed 3 families (12.50%), 15 genera (35.71%) and 20 species (36.36%). The fish diversity of river Subansiri is mainly dominated by Barils (*Barilius bendelisis*, *Opsarius barna*), Barbs (*Puntius terio*, *P. sophore*, *P. chola*), Loaches (*Acanthocobitis botia*, *Lepidocephalichthys guntea*), carps (*Labeo gonius*, *L. calbasu*, *L. bata*, *L. rohita*, *Cirrhinus mrigala*) and miscellaneous species (*Nandus nandus*, *Glossogobius giuris*, *Chaca chaca* etc.). As per IUCN conservation status, 51 (92.72%) species were recorded as Least Concern, 2 (3.64%) species under near threatened, 1 (1.82%) species under vulnerable and 1 (1.82%) species under endangered category. Margalef's richness index (d) was found to be the highest in Monsoon at station 3 (9.098) and the lowest again at station 3 (7.942) in the pre-monsoon season. Buzas and Gibson's evenness index (E) was found to be the highest at station 1 (0.8359) in post monsoon and the lowest at station 1 in monsoon season (0.763). The Shannon- Weinner index (H') was found to be the highest in pre monsoon season at station 2 (3.668) and the lowest in post monsoon season at station 2 (3.479). The Simpson index (1-  $\lambda'$ ) was found to be the highest in pre monsoon season at station 2 (0.9702) and the lowest in post monsoon season at station 2 (0.9635). It indicates a diverse fisheries potential of the river and rich distribution of fishes across the river. Altogether 40 genera belonging to 34 families, 25 orders under 12 classes recorded from 3 different stations of Subansiri river. Bacillariophyceae formed the largest group with a contribution of 7 orders (28%), 10 families (29.41%) and 11 genera (27.5%). The planktonic groups of Subansiri mainly dominated by Naviculales (*Craticula*, *Frustulia*, *Navicula* and *Pinnularia*), Desmidiaceae

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(*Closterium acutum*, *Closterium incurvum*, *Cosmerium* and *Penium*), Fragilariales (*Fragillaria*, *Synedra*, *Tabellaria flocculosa*) and Cladophorales (*Pithophora*, *Cladophora*, *Rhizoclonium*) etc. The mean value with regard to physico-chemical parameters of river Subansiri were moderate surface water temperature, (14.6 °C - 24.0 °C), slightly acidic to moderately alkaline pH (6.05-8.14), dissolved oxygen (4.10 - 6.81 mg/l), total dissolved solids (55.6- 153.2 mg/l), specific conductivity (70.8-164.1  $\mu$ S/cm), moderate total alkalinity (35.64- 82.45 mg/l), water current (1.30- 2.15 m/sec) and water transparency (30.4-54.2 cm). Thus the different water quality parameters recorded indicate a favorable condition for the growth of aquatic organism nearly round the year.

# **Study on Ichthyofaunal Diversity and Physico-Chemical Parameters of a Floodplain Wetland (Jaluguti *Beel*, Morigaon District, Assam) of Central Brahmaputra Valley Zone**

*Sheetala Chintey*

The present study was conducted to evaluate the ichthyofaunal diversity and habitat ecology of *Jalugutibeel*, Morigaon district of Assam, for a period of one year from May, 2020 to April, 2021. A total of 46 fish species belonging to 33 genera, 19 families and 7 orders were recorded from the *beel*. The order Cypriniformes comprised of 3 families (15.79%), 14 genera (45.71%) and 20 species (43.48%) contributing to the total. Six families (31.58%), 7 genera (20%) and 9 species (19.57%) made up the order Perciformes. With 5 families (26.32%), 6 genera (17.14%) and 10 species (21.74%), the order Siluriformes contributed a significant portion to the total number and percentage composition of the *beel*, followed by Synbranchiformes with 2 families (10.53%), 3 genera (8.57%) and 4 species (8.70%), and the orders Clupeiformes, Osteoglossiformes and Beloniformes were represented by 1 family (5.26%), 1 genera (2.86%) and 1 species (2.17%) each. Fisheries of Jaluguti *beel* was mainly dominated by *Parambassis ranga*, *Chanda nama*, *Pachypterus atherinoides*, *Chela cachius*, *Salmostoma bacaila*, *Amblypharyngodon mola*, *Mystus bleekeri* and other miscellaneous species. Under IUCN conservation status (2021), the highest species were recorded under Least Concern (LC) category with a total number of 37 and contributed 80.43%. Under LC category, majority of the species belonged to the family Cyprinidae with 13 (28.26%) followed by Bagridae 4 (8.70%), Mastacembelidae and Channidae 3 (6.52%), Cobitidae and Ambassidae 2 (4.35%) each. Balitoridae, Notopteridae, Clupeidae, Heteropneusteidae, Schilbeidae, Synbranchidae, Nandidae, Gobiidae, Osphronemidae and Belonidae with 1 species contributed 2.17% each. Under Near Threatened (NT) category Siluridae and Cyprinidae contributed 3 (6.52%) and 1 (2.17%) species, respectively. Under Data Deficient category both Anabantidae and Cyprinidae contributed 1 (2.17%) each and under vulnerable, endangered and near threatened

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category contributed 1 (2.17%) each. Margalef's Richness Index (d), Pielou's Evenness Index (J), Shannon -Weiner Index (H') and Simpson Index (1- $\lambda$ ) indicated high fish diversity in the *beel*, with a more or less even distribution of fish genera indicating that the *beel* was in good condition for fish production. During the study period, a total of 20 genera of phytoplankton and 13 genera of zooplankton were recorded in the *beel*. Bacillariophyceae dominated among the phytoplankton and rotifera were dominated among the zooplankton group. The majority of physico - chemical parameters.were found to be in a favorable range for aquatic species growth and reproduction. Water temperature of Jaluguti beel were ranged from 18.4 °C to 29.8 °C, water pH from 5.5 to 7.3, dissolved oxygen from 4.5 mg/l to 6.9 mg/l, total alkalinity from 42.10 mg/l to 68.10 mg/l, total hardness from 50.0 to 69.2 mg/l, specific conductivity from 83.7  $\mu$ S/cm to 110.0  $\mu$ S/cm, free carbon dioxide from 5.3 mg/l to 9.6 mg/l, turbidity from 3 NTU to 4.7 NTU, and ammonia-nitrogen were ranged from 0.14 mg/l to 0.19 mg/l. Anthropogenic activities in the beel such jute retting, household and domestic wastage, dumping of salted water used in drying fish at beel periphery may pose threats to the fish diversity of the *beel*.

## **Master of Science (Home Science)**

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- **Extension and Communication Management**
  - **Family Resource Management**
  - **Food Science and Nutrition**
- **Human Development and Family Studies**
  - **Textile and Apparel Designing**



## **Knowledge and practice of adolescent girls of Jorhat district of Assam on personal hygiene with special reference to menstrual hygiene**

*Anwasha Bijoy Chetia*

The present investigation was conducted to study the “Knowledge and practice of adolescent girls of Jorhat district of Assam on personal hygiene with special reference to menstrual hygiene” with objectives : (i) To study the background profile of adolescent girls (ii) To assess the existing knowledge of respondents on personal hygiene with special reference to menstrual hygiene (iii) To identify the existing practice of respondents on personal hygiene with special reference to menstrual hygiene. The study was conducted in one Educational Block of Jorhat District of Assam namely Jorhat Educational Block. Twenty five (out of total 32 clusters) numbers of clusters having high school or higher secondary school were considered for the present study. As there are 20 clusters situated in rural area and 5 clusters are in the urban area, 50 per cent clusters of rural areas that is 10 nos. and 50 per cent clusters of urban areas that is 3 nos. were selected randomly for the present study. One high school or higher secondary school from each cluster was selected by using simple random sampling method. Thus, all total 13 numbers of high schools or higher secondary schools were considered for present study, 10 schools from rural and 3 schools from urban area were selected for the present study. From the total number, thirty percent girls belonging to 15 years to 19 years (late adolescent) were the respondents for the present study. Thus, all total 142 numbers of late adolescent girls (15-19 years of age belonging to class IX to XI) from the rural area and 112 numbers of late adolescent girls totaling 254 numbers of late adolescent girls from both rural and urban area of Jorhat district were the respondents for the present study to assess knowledge and practice of personal hygiene with special reference to menstrual hygiene. The study revealed that a higher percentage of respondents in both rural and urban area belonged to the age group of 15-17 years and respondents from both the areas respondents attained menarche at the age of 13-15 years. The study revealed that majority of the total respondents had no separate bathroom in their house for using during menstrual period. It is found that ‘menstrual hygiene’ is included in the syllabus of school. Majority of the respondent discussed

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about menstrual hygiene with their family. The findings showed that majority of the total respondents that nearly 53 per cent respondents had attended training on menstrual hygiene and remaining respondents who had not attended any training on menstruation were interested in obtaining training on menstruation. More than 36 per cent respondents had the menstrual cycle with the interval of 28 days. Nearly 78 per cent respondents did not consult with doctor if face any problem regarding menstruation and they did not use any local (indigenous) medicine during menstrual period. The study showed that higher percentage of respondents from both the rural and urban area had medium level of knowledge on personal hygiene with special reference to menstrual hygiene. The study also revealed that a higher percentage of overall respondents that is 69.29 per cent belonged to “moderate” category on menstrual hygiene practice. The study showed that there was highly positive significant relationship of menstrual hygiene knowledge with independent variable such as mass media exposure and there was positive significant relationship of menstrual hygiene knowledge with independent variable such as training attended. There was highly positive significant relationship of menstrual hygiene practice and independent variable such as size of the family and training attended. There was positive significant relationship of respondents’ knowledge on menstrual hygiene with their practice on menstrual hygiene in rural area.

## **Knowledge and practice of farmers in production of mushroom for livelihood security**

*Debasish Saikia*

Mushroom is a delicacy with high functional and nutritional value. It has been historically used as a nutritional source across the world. Mushroom cultivation requires less land and is basically an indoor activity. It can be started by landless farmers, unemployed youths, rural women and other entrepreneurs. The study on Knowledge and Practice of Farmers in Production of Mushroom for Livelihood Security was conducted with four objectives- (I) To study the background profile of the farmers engaged in mushroom production. (II) To assess the existing technological knowledge of the farmers on mushroom production (III) To identify existing practices of respondents in production of mushroom (IV) To find out the problems faced by the respondents in production of mushroom. The study was conducted in Jorhat district of Assam using snow ball sampling method. Sample size for the study was 60 (sixty). The study revealed that 41.67 per cent respondent was in the age group 31-41 years, 66.66 per cent were married and 33.34 per cent had passed higher secondary. More than 80.00 per cent respondents belonged to nuclear family with small family size. Fifty per cent respondent had farming as their primary occupation and regarding occupation of the respondent's majority of the respondents (80.00%) were involved in farming, 33.33 per cent williness for continuation of mushroom production, Higher percentage of the respondent (66.67%) were engaged in mushroom production more than one time. The findings shows that highest percentage (66.67%) of respondents had medium level of knowledge on mushroom production whereas majority (81.67%) had moderate level of practice. However in certain aspects the respondents had no knowledge such as 'how long paddy straw should be soaked in fresh water', 'usage of brown bag for storing harvested mushrooms', 'the recommended soaking time for the paddy straw' etc. . Though majority had moderate level of practice some aspects are not at all adhered to including 'do not use brown beg', 'did not make any value-added products, etc. Majority of the respondents reported problems in mushroom production such as 'Unavailability of quality spawn in mushroom Production', 'Lack of input', 'Lack of government scheme', 'Lack of assured market', 'Price fluctuation of the mushroom'.

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The study concludes that there is an urgent need to remove hindrances for accelerated adoption of mushroom enterprise for income generation. For sustainability and expansion of the mushroom sector in order to ensure the livelihood security of the farmers there should be encouragement from the Government and other concerned authority by providing necessary input support and marketing and storage facility.

## **Aspiration of Rural Youth towards Agriculture as an Enterprise for Livelihood Security**

*Gayatri Gogoi*

The unemployment rate for youth is increasing day-by-day and young people had facing this problem more severely. Due to the problem they are migrating to urban cities in search of better job opportunities. Where agricultural entrepreneurship plays a vital role in social and economic development of the country, it is questionable issue of migration of rural youth. Thus the present study was undertaken to study the “Aspiration of Rural Youth towards Agriculture as an enterprise for Livelihood Security” with following objectives – i) To study the background profile of the rural youth, ii) To assess the attitude of rural youth towards agriculture as an enterprise, iii) To find out the factors that influences the interest of the rural youth towards agriculture as an enterprise, iv) To explore constraints of rural youth in taking agriculture as an enterprise. The study was conducted in Jorhat subdivision and Titabor subdivision of Jorhat district of Assam. Multistage Proportionate Random Sampling technique was followed for the present study. Four villages were selected randomly from two subdivisions. From the 4 villages 138 numbers of male youth were selected proportionately. The data was collected through structured questionnaire prepared by the researcher. Collected data were analyzed by applying frequency, percentage, mean, standard deviation, chi-square test, Pearson Correlation and factor analysis. The findings revealed that majority (54.34%) of the respondents belong to early youth group i.e. 21-25years and Hindu (96.37%). Majority of the respondents (95.65%) were unmarried and 43.00 per cent had education up to graduation level. Half of the respondents had service as their family occupation. They mostly belonged to nuclear (67.39%) and small size family (65.21%). Fifty per cent of the respondents belonged to marginal land holdings and unemployed (30.43%) and had mixed type of house (60.86%). Majority of the respondents 55.00 per cent and 75.00 per cent of the respondents had medium level of household assets and farm assets respectively. Cent percent of the respondents using mobile phones and participate in discussion meetings (60.86%). They had regular contact (20.30%) with bank personnel. It was found that majority (72.50%) of respondents had favorable attitude on agriculture as an enterprise. From the factor analysis there are eight factors were extracted because

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data shows eight components with Eigen value greater than 1. Variables under social factor had high influence the interest of rural youth towards agriculture as an enterprise. Most of the respondents had faced common problems like lack of economic investment (66.66%), lack of appropriate machineries (43.33%), and insufficient land holding due to family division (40.41%).

## **Impact of Farmers' Fair on Technology Adoption**

*Kabyashree Bora*

The study entitled “Impact of Farmers’ Fair on Technology Adoption” was undertaken with the following objectives: 1) To explore the participation of rural people in Farmers’ Fair organized by AAU, 2) To identify different technologies showcased to the farmers through Farmers’ Fair organized by AAU, 3) To study the extent of adoption of different technologies disseminated by Regional Agricultural Research Station (RARS), Titabar and Sugarcane Research Station (SRS), Buralikson through Farmers’ Fair, 4) To find out the problems faced by the farmers to adopt different technologies. The study was carried out in the state of Assam where six Regional Agricultural Research Stations and five Commodity Research Stations are functioning under administrative control of Assam Agricultural University, Jorhat. A purposive sampling was followed for selection of institutions, Regional Agricultural Research Station (RARS), Titabar, Jorhat and Sugarcane Research Station (SRS), Buralikson, Golaghat was selected as these two constitutions conduct Farmers’ Fair regularly. Two (2) adopted villages from each institution were selected by using simple random sampling method. Thus total four (4) numbers of villages were finally selected for carrying out the present research study. For selection of the respondents, thirty (30) respondents who have visited Farmers’ Fair in the last five years were selected from each village by using simple random sampling. Altogether one hundred twenty (120) farmers were selected as respondents for the present study. Secondary data was collected to explore the participation of people in Farmers’ Fair organized by AAU and to identify different technologies showcased to the farmers through Farmers’ Fair. Primary data was collected to study the extent of adoption of different technologies disseminated by RARS, Titabar and SRS, Buralikson and to find out the problems faced by farmers in adopting those technologies. For collection of Primary data, an interview schedule was prepared and the data was collected personally through face-to-face interview method. It was observed that the highest turn out to the Farmers’ Fair came from the district where these institutes are based, the same applied for Regional Agricultural Research Station (RARS), Titabar, Jorhat and Sugarcane Research Station (SRS), Buralikson, Golaghat. Each year the participation of male was higher than the participation of female. A large number of respondents were from lower middle age

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group (58.33%), married (71.67%) and had middle school level of education (43.33%). Majority of the respondents can read (94.17%), write (92.50%) and speak (100.00%) Assamese language and a large number of respondents belonged to General caste 7 (45.00%). The main occupation of a large number of respondents was cultivation and business (75.83%) and belonged from a joint family (43.33%) and the size of the family was medium (52.50%). A large number of respondents had semi-medium size (43.33%) of land holding and the personally owned the land (65.00%). A little more than half of the respondents monthly income was in the range of Rs.5,000-Rs. 15,000 (50.83%) and majority of the respondents possessed furniture (93.33%) as household assets, Hand tools (100.00%) as farm assets, 2-wheelers (94.17%) and a large percentage of respondents had mobile (85.00%) and television (80.00%) as media possession. A large number of participants (62.50%) were member of more than one organization and had occasional contact with University personnel (54.23%). The overall socio economic development status of the respondents is medium (71.7%) and also had a medium level (64.17) of mass media exposure. Medium level of adoption (58.33%) was seen in overall extent of adoption of all the technologies showcased in Farmers' Fair by Regional Agricultural Research Station (RARS). Overall extent of adoption of technologies was low (50.00%) in Sugarcane Research Station (SRS). Low level of adoption was seen in SRS as the adopted villages under RARS were not involved in sugarcane cultivation. The main constraints in adopting the technologies were that the farmers did not get appropriate price after selling of certain rice and sugarcane varieties and value added products of sugarcane, absence of a proper market structure and involvement of middlemen was a great problem.



## **Digital Literacy Among Rural People of Assam**

*Munmi Boruah*

The study on Digital literacy among rural people of Assam was conducted with the objectives (i) To study the socio economic profile of the respondents, (ii) To assess the knowledge, attitude and practices of the respondents on Digital literacy, (iii) To explore the problems faced by the respondents in using Digital devices and services, (iv) To find out the differences in the digital literacy between men and women. The present study was conducted in the Jorhat and Golaghat District of Assam. The Krishi Vigyan Kendra Jorhat, Kaliapani, and Krishi Vigyan Kendra Golaghat, Khumtai were selected, from which all the adopted villages were enlisted and then three numbers of villages from each Krishi Vigyan Kendras i.e 6 numbers of villages were randomly selected. From each selected village twenty respondents were selected randomly where ten were men and ten were women. So the total number of respondents was 120 numbers. The study revealed that more than one third (37.50%) of the respondents were belonged to lower middle age group i.e. 34-45 years. Majority of the respondents (75.00%) were married, high majority (95.83%) of the respondents were literate and 52.51 per cent were belonged to Other Backward Caste (OBC). It was found that the main occupation of slightly more than one third (35.00%) of the families were farming and 65.00 per cent of respondents had marginal land holdings. It was found that more than half (56.70) of the respondents was belonged to medium level of digital media possession category. It was found that almost half of the respondents (49.17%) were member of at least one organization. The majority (70.83%) of the respondents found to be in the category of the medium level of socio-economic status. It was found that only 16.67 per cent of the respondents attended training on use of computer. The findings indicated that majority (55.83%) of the respondents had medium level of knowledge regarding the digital literacy, followed by high level of knowledge (24.17%) and low level of knowledge (20.00%). The data showed that almost half (44.17%) of the respondents had a moderately favourable attitude towards digital literacy, Followed by 22.50 per cent of respondents had highly favourable attitude whereas 33.33 per cent of the respondents had least favourable attitude towards digital literacy. The data indicated that the more than half (55.00%) of the respondents belonged to “low” category on digital activities practice, followed by medium level (26.67%) and only 18.33 per cent of the respondents

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had high level of practice of digital activities. Among the various problems faced by the respondents in utilization of digital devices “Fear of committing any mistake” was ranked I (5.00), followed by “High cost of internet packs” ranked II (4.98), “Poor network connectivity” ranked III (4.66), “Erratic power supply” ranked IV (4.57) and “High cost of repairing digital devices” ranked V (4.44). It was found that there was no significant difference between men and women regarding knowledge and attitude towards digital literacy. But at the same time it has high significant difference at 0.01 levels in practice of male respondents on digital activities with the practice of female respondents on digital activities

## **Financial Literacy Among Young Employees: A Study in Assam Agricultural University, Jorhat**

*Poonam*

The study entitled —Financial Literacy among Young Employees: A Study in Assam Agricultural University, Jorhat‡ was undertaken with the objectives: 1) To study the background profile of the respondents, 2) To identify the level of financial literacy among the respondents and 3) To study the relationship between knowledge and attitude of respondents with selected independent variables. The study was carried out in the Jorhat campus of Assam Agricultural University. Thirty teaching respondents and 30 non-teaching respondents who were below 50 years of age were randomly selected for the study. Thus, a total number of 60 respondents were included for the study. Findings revealed that 60.00 per cent teaching respondents and 46.67 per cent nonteaching respondents belonged to the age group of 31 – 40 years, 96.67 per cent teaching and 63.33 per cent non-teaching respondents were married, 86.67 per cent and 56.67 per cent respondents were female among teaching and non-teaching respondents respectively. More than 60.00 per cent teaching respondents had doctoral degree and 53.33 per cent non-teaching respondents were post graduate. Highest percentage of the respondents were from general caste and 66.67 per cent teaching respondents belonged to urban area while 43.33 per cent non-teaching respondents belonged to semi-urban area. Highest percentage were from nuclear and small family. Forty per cent teaching respondents had their monthly income in the category of Rs.100001-200000 and 43.33 per cent non-teaching respondents had Rs.50001-10000. Among the teaching respondents 53.33 per cent were not aware about any programmes related to financial literacy; on the contrary, among the non-teaching respondents 53.33 per cent respondents were aware about such programmes. Regarding financial problem, ‘\_unexpected expenses’ was reported as a problem by 60.00 per cent of the teaching respondents, while ‘\_spending money in unnecessary things’ was reported as a problem by 56.66 per cent. Among the non-teaching respondents, 36.66 per cent reported ‘\_unexpected expenses’ as a problem. Large majority of teaching respondents (93.34%) and non-teaching respondents (80.00%) saved money for future while around 60.00per cent respondents used to make investment. Around 60.00 per cent of the respondents,

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had the habit of making budget and majority of the respondents did not take any credit. Regarding knowledge on financial matters, 80.00 per cent teaching respondents and 66.67 per cent non-teaching respondents had medium level of knowledge related to financial matters. As far as attitude towards financial matters was concerned, 73.33 per cent teaching respondents and 63.33 per cent non-teaching respondents had moderately favourable attitude. Knowledge and attitude of respondents with age and year of service was found to have significant relationship.

# **Public-Private Partnership for Marketing Management of Selected Woven Products for Weavers of Assam for Sustainable Economic Development**

*Sangeeta Borah Saikia*

The present investigation on “Public-Private Partnership for Marketing management of selected woven products for weavers of Assam for sustainable economic development” was undertaken with the objective of (i) to study the profile of weavers (ii) to analyze the status of existing knowledge and practice of Marketing strategy of weavers of Assam (iii) to develop skill of the selected weavers for producing diversified woven product (iv) to find out problems of weavers (v) to develop strategy for proper marketing management of woven products through linkage with line departments. The study was conducted in two agro-climatic zones of Assam. A multistage purposive sampling method was used. The research design used was survey cum experimental design. One district from each zone namely Dibrugarh district from Upper Brahmaputra Valley Zone and Lakhimpur district from North Bank Plain Zone were purposively selected considering engagement of weavers in those areas. Altogether 300 respondents were undertaken for the study. An intervention programme was given by conducting training on selected utility handwoven products in order to develop marketing strategy. Data collection was done by using structured schedule. The findings of the study revealed that majority of the respondents (61.00%) belonged to upper middle age group, large majority (97.67%) were married, nearly half of the respondents (47.67%) had education upto primary level, majority (62.33%) were from Nuclear family, majority (46.67%) were Schedule Caste, large majority (96.00%) had farming as family occupation, majority (90.00%) of them were member of self help groups, almost all (99.00%) had interaction with others with mobiles, cent percent had linkage with Nationalized Bank, (97.00%) of the respondents had katcha weaving place. After categorizing the surveyed data of the respondents into high, low and medium category on existing status of knowledge and practice of marketing strategy it was found that, very less (6.00%) of respondents had high level, more than one-fourth (33.00%) of respondents had low level and 61.00% of respondents had medium level of knowledge

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and practice of marketing strategy of handloom products. There was significant association between existing knowledge and practice of Marketing strategy with caste, education and age in the aspect of Product, People, Price and Promotion of Marketing. Marital status is not significantly associated with product. Insufficient raw material and lack of financial support from bank were the major problems which ranked 1st and 2nd . For solving problems, 28.00% of respondents availed help from family members followed by (8.33%) from bank. Of the selected woven products as high as 60.00% of cushion covers were sold in office followed by yoke (56.67%) and 50.00% apron were sold in office. Impact of the intervention programme conducted under public-private mode was found to be effective with the sample of the study in developing skill for preparation of diversified products which finally helped them in income generation of the family. Hence same initiative i.e giving interventions and conducting programmes under public-private mode covering more weavers from different places was felt for upliftment of the whole handloom weavers of Assam.

# **Workspace environment of the Computer operating Employees in Banking Sector- An Analysis**

*Animesh Gogoi*

The banking sector is a part of a nation's economy as banks play vital role in implementing and planning of the financial policy. All the transaction of money and financial issues come under the banking sector. So it is very important that the employees have very good mental and physical status to deliver their responsibilities to the utmost perfection. A good work space environment can lead to high productivity where as a poor workspace environment can cause problems to the workers and the organization. Comfortable and ergonomic office design motivates the employees and increases their performance substantially (Deshpande, 2013). Furthermore, work stress can affect workers in many ways; from lowering resistance to illnesses and depriving them of sleep, to interfering with their concentration as a result more injuries and accidents occur (Adeyemi 2013). This study was aimed to investigate musculoskeletal disorders and onset of stress and its relationship due to the effect of workstation factors like illumination, temperature, humidity, noise, office furniture and colour of walls on computer operating employees of banking sector of Jorhat town. Data was collected through the use of questionnaire and observation methods from 129 bank employees and was analysed through statistical methods. About 40.3% employees (28.63% Male and 11.62% Female) were found to suffer from different musculoskeletal problems. The study found a significant relation with some workstation environment factors and musculoskeletal disorders. Apart from this, some workstation environment factors were also found to have significant relationship with stress outcome of the employees. The study suggested that people must understand their workspace environment factors and should design it in terms of their body requirements and adhere to recommended ergonomic specifications in a proper way for better performance and productivity maintaining good health and wellness.

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**Major Adviser: Dr. Bijoylaxmi Bhuyan**

## **Study of consumer awareness and buying practices towards green products**

*Askino R. Marak*

A study on consumer awareness and buying practices towards green products was undertaken in municipality area of Jorhat. The objectives of the present study were: (1) To study the awareness of consumers regarding green products, (2) To study consumers buying practices towards green products. A multistage random sampling was adopted to carry out the study. The municipality area of Jorhat was selected and from the total number of wards, five wards were selected randomly. From each of the selected wards, households were selected by following probability proportionate to size method. Thus, 120 respondents were selected for the study. Personal interview method was used for the collection of data. The findings of the personal and demographic characteristics of the respondents showed that majority of the respondents (55%) belongs to the younger age group, most of them (59%) are graduate. 79 per cent of respondents belonged to a nuclear family, and 77.5 per cent have family members between 1-5. It was found that 44 per cent were from families with monthly income of Rs. 25001-50000/-. The findings related to the reasons which led the consumers to purchase the green products showed that 56.6 per cent of the respondents are concern for health, 47.5 per cent of the respondents purchase the green products because they are chemical free products. Among all the sources of information, social media was the highest with the percentage of 55 per cent through which the consumers get information regarding green products. The knowledge regarding the environment and green products showed that majority of the respondents (82.5%) have known that green products are biodegradable. Based on the knowledge of eco-label, large numbers of respondents (43.3%) have known that ecolabel give information about the green product. Regarding the awareness level of respondents towards green products, it was found that large numbers of the respondents are highly aware with regards to green food product (59%) and green cosmetic and personal care products (54%) when compared to other green products such green electrical appliance, green furnishings and wall paints and green household cleaning products. The overall awareness level of respondents showed that 53 per cent 6 have high level of awareness regarding green products. On the basis of the buying practices of respondents towards green products, the findings revealed that 42 per cent

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of respondents are found to have a good buying practice regarding food items and 47 per cent in green cosmetics. The overall findings of buying practices showed that 42 per cent of respondents have a good level of buying practices, while 19 per cent of respondents are found to be in the category of average buying practices, whereas 39 per cent respondents have poor level of buying practices.

## **Assessment of Environmental Parameters in Domestic Kitchen of Jorhat Sub-Division**

*Kimbai A. Sangma*

Nowadays, energy consumption, environmental protection and safety are fundamental issues in design process. Environmental parameters such as temperature, humidity, light, noise etc have a profound effect on human performance, efficiency and efficacy. The present study entitled “Assessment of Environmental Parameters in Domestic Kitchen in Jorhat Sub Division” was proposed with following objectives: (1) to study the demographic profile of the respondents. (2) To measures the temperature, humidity, illuminance and noise level in the kitchen during cooking. (3) To study the relationship between dependent and independent variables. A purposive cum random sampling method was adopted. Out of 19 wards in Jorhat Municipality area 3 wards were selected randomly and 5 per cent sample thereby 56 numbers of household were selected randomly. The women who involved in cooking activity will be the sample for the present study. Both interview and observation method was used for collection of data which was done through a questionnaire and observation for measurement of temperature, humidity, and Illuminance and noise level. Instruments used for measurement i.e., thermo-hygrometer, lux-meter and noise level-meter. Further chi square test was done to identify the relationship between variables. The findings showed that the average temperature was found to be 30.55°C which is found more than acceptable limit i.e., 22.2 °C to 26.6 °C, humidity was found to be 75.65 per cent which is higher than the acceptable value (30 % to 60 %), illuminance level was found to be 140.25 lux which is lower than the acceptable limit of 300 lux and the average noise level was found to be 64.70 dB which is more than the permissible or acceptable level of noise (55 dB). The study revealed that there is a significant relationship between noise with brand name of the kitchen chimney (,p”=0.041\*). It was also emphasize that majority of the respondents were not aware of environmental parameters, hence a guidelines was developed for creating awareness and for conducive environment in the kitchen to improve their performance.

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# Assessment of Occupational Health Hazards of Office Employees

*Malobika Gogoi*

A place where professional task and managerial activities of an organization is carried is termed as an office. Computers are used for a long period of time without taking appropriate breaks in between that affects vision causes pain in the neck, upper back, shoulders arms etc. Keeping in mind the study on „Assessment of Occupational Health Hazards of Office Employees“ was undertaken with the objectives - a) to study the activity profile of the computer users, b) To assess the occupational health hazards of computer users, c) to analyze the posture assumed by the computer users and d) to find out the relationship between selected dependent and independent variables. A total of 110 samples were selected purposively from the educational institutes of the Jorhat district of Assam. For the study both interview and experimental methods were used for gathering the data. The tools for the study were grooved peg board for dexterity and eye hand coordination and flexi-curve for postural deviation was used. A three point scale was applied for assessing health hazards and to identify body part discomfort of the body parts a five point scale (Corlett and Bishop, 1976) was used. Further chi square analysis was done to determine the relationship between variables. The findings showed that total hours spent on computer every day was observed to be 88.20 per cent for 6-8 hours. About half of the respondents (51.80%) took rest for 30 minutes. On analyzing the different occupational health hazards it was observed that headache was the most frequently occurring health hazards and Rank I similarly, head ranked -I with a mean of 2.29. A deviation of 2.15 per cent was found to be for upper back similarly 0.87 per cent was found to be for lower back. Data revealed that there was no relationship between gender and occupational health hazards ( $p=0.510$ ) but significant relationship between age ( $p=0.000^{**}$ ) and years of involvement ( $p=0.004^{**}$ ). Similarly, for total body discomfort no significant relation was found between gender ( $p=0.238$ ) and years of involvement ( $p=0.118$ ) whereas age was found to be highly significant ( $p=0.00^{**}$ ). Regarding the relationship between postural deviation with age, gender and years of involvement, there lies a significant relation between age and years of involvement ( $p=0.047^{**}$  and  $p=0.041^{**}$ ) and no relation with gender ( $p=0.899$ ). Preventive programs can be introduced to the employees so as to put awareness and to prevent of the health hazards and musculoskeletal disorders among the office employees.

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# Packaging and Consumer Buying Behaviour

*Mriganka Sonowal*

In today's competitive market packaging and its aesthetic elements have occupied an important and unique position in delivering the product to the end users. It has become important tool of differencing the product from the similar kinds of products available in the market. It attracts consumers' attention to particular brand, packaging enhances the product image and influences consumers' perception about the product or service. The appearance of the package is believed to have a strong impact on influencing consumers' purchase decision. Keeping it in mind the present study was taken up on Packaging and consumer buying behaviour with the objectives 1) To find out the different packaging materials used for food items. 2) To find out the impact of packaging on the buying behaviour. 3) To see the relationship between packaging elements and consumer buying behaviour. For the present study a purposive cum random sampling method was adopted for selecting the samples in order to fulfil the objectives of the study. A total of 170 women were selected randomly through PPS (Probability Proportionate to sample) technique was followed. To determine the reliability of the instrument and to check simplicity, content and clarity of language of the interview schedule pretesting was done. The instrument was administered with 20 non sampled women. It helped the investigator to finalize the interview schedule. The findings showed that among all the packaging material plastics are used mostly in all the food products. Packaging can be divided into different elements which creates an impact on the minds of the consumer to purchase a product. It is divided into two categories: visual which includes graphics, colour, shape, and size and informational which includes information provided and innovation. In the present study we can say that packaging elements play a vital role in decision making of purchasing a product Among the elements we see that packaging color, packing material, packaging design and innovation have significant relation with the buying behaviour. So, the marketers can emphasize on these elements to compete with its competitors and to boost the sales of product in the market. Future researchers can formulate this study for further examination of every feature and its effect on product packaging, explanation of impact of packaging features in relation with other categories of product or conduction any comparative study to possibly identifying different effects of packaging features on a variety of similar or different products.

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## **Utilization of institutional microfinance by beneficiaries – A study in Sivasagar district of Assam**

*Parthapratim Gogoi*

Microfinance is an approach of economic development that involves providing financial services, through institutions, to low-income people, where the market fails to provide appropriate services. In present scenario this is found to be an effective instrument for lifting the poor above the level of poverty by providing them selfemployment opportunities and making them credit worthy. In India Micro finance programme was formally initiated by National Bank for Agriculture and Rural Development (NABARD) in 1992, Like India, in Assam also during past years, (since 2001) the sector has witnessed a sharp growth with the emergence of a number of Micro Finance Institutions (MFIs) that are providing financial and non-financial support to the poor in an effort to lift them out of poverty. But many times it has been seen that beneficiaries are not utilizing micro finance loan for income generation, rather they utilize in non productive work. Sometimes beneficiaries do not have control in utilizing loan, in such case whether beneficiaries could managed repayment? Whether beneficiaries are actually benefited? Whether services of MFI's are satisfactory? Considering these points the present research has been conducted with the objectives: 1. To study socio economic profile of beneficiaries. 2. To study quantum of loan availed, their utilization and repayment by the beneficiaries. 3. To access level of satisfaction of beneficiaries towards micro finance services of MFI's. One hundred and twenty numbers of total beneficiaries have been selected from Sivsagar district of Assam by adopting multi stage samplings techniques. Findings of the data depicts that beneficiaries in the study area came to know about institutional micro finance mostly from MFI representatives working in their area and other sources like advertisement in TV/Radio/Newspapers, Posters, Hoardings etc. Beneficiaries association with multiple MFI's found among highest percentage of beneficiaries in study area. Only 30.0 percent of the beneficiaries utilized the loan amount by themselves. Utilization of micro finance loan by husband and other family member along with beneficiaries found among majority of beneficiaries household. Moreover loan utilization was found mostly in

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traditional activities like livestock, petty business, agriculture etc. Study also revealed that diversifications of loan amount to unproductive purpose are common in study area. Regarding repayment of loan it was found that 62.6 percent of the beneficiaries were found as defaulter due to various reasons and more prominent reasons are improper use of loan and insufficient income. From KMO and Bartlett's Test, it is found that some factor had positive influenced on repayment of institutional micro finance loan, example: microfinance loan helps in rejuvenate and expansion of old petty business , MFI improved overall socio economic status of a family etc. whereas some factor had negatively influenced on repayment status of institutional micro finance loan like: diversified micro finance loan for unproductive purpose, frequency of loan repayment is not comfortable etc. Beneficiaries perception towards institutional microfinance programme revealed that micro finance program is helping more in personal development than economic and social development. Overall satisfaction level was found medium among beneficiaries in study area. From the study it can be concluded that though emergence of microfinance service is for economic empowerment of women by involving themselves in some income generating activity but in study area most of the loan are utilized by other members of the family. As a result their involvement in economic activity was very poor but burden of repayment lies on them. Default of loan repayment is mainly associated with diversification of loan for unproductive purpose. Moreover, during the study period Covid-19 pandemic has badly affected many beneficiaries income generating activities, as a result many people became defaulter of loan during this period. Lastly, for revival of rural economy and empowerment of the rural poor specially women, recipient also needs to understand purpose of microfinance and utilize loan in a more productive way so that the magnitude of return will be more than existing condition.

## **Prevalence of ergonomics risk factors and work related health problems at work: Special reference to filigree work of Odisha**

*Sarmistha Mishra*

Ergonomic risk factors are prevailed among the workers, especially the workers in the production units leading to work related health problems. Keeping this in view a study was conducted on 222 workers engaged in performance of different activities in silver filigree work in Cuttack district, which was selected purposively. The wards from Cuttack city were selected based on the criteria of simple random sampling with the following objectives- 1. To study the work related health problems prevalent among the workers engaged in filigree art, 2. To find out the ergonomic risk factors causing health problems, 3. To suggest measures to minimize work related health problems among the workers. Data were collected through observation and interview method. While performing different activities, workers found to be assumed squatting and standing postures with variety of joint movements which were studied by observation analysis. Flexi curve was used to study the postural deviations at lumbo-sacral and cervical regions. Analyses of postures revealed that the workers used to assume a variety of joint awkward postures while performing different silver filigree activities due to the demand of work and workstation design. As regards to exertion perceived in performance of various filigree activities, it was found that matching the frame with the sketch / Design making activities was reported as the very heavy activity. Work related musculoskeletal problems were quite prevalent among the workers. Low back, upper back and finger pain were found very common among the workers which was followed by neck, knee, and shoulder pain. Analysis of data revealed that significant positive relationships existed between age, year of involvement, perceived joint discomfort and work related musculoskeletal problems faced by the works so it can be concluded that there is relationship between the works related musculoskeletal disorder with perceived joint discomfort. The scope for design development was explored and attempt had been made to design a tool for design making activities because it was found to be performed on a daily basis in all of the silver filigree working area surveyed. The matching the frame with the sketch / Design making activities of filigree work was reported as labour

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intensive and tedious work by the respondents. So from the field trails, on the basis of the ease of comfort a tweezers with non-slippery rubber was selected as the best work tool for matching the frame with the sketch / Design making activity.



## **Hypocholesterolemic and hypoglycemic effects of multi-strain probiotic beverage**

*Deeptimayee Mahapatra*

The present study entitled “Hypocholesterolemic and hypoglycemic effects of multi-strain probiotic beverage” has been undertaken to develop a orange beverage with different combinations of probiotic strains namely *Lactobacillus bulgaricus*, *Lactobacillus casei*, *Lactobacillus gasseri* and *Lactobacillus fermentum*. The results of physical property evaluation of the oranges showed that the average weight of orange (*Citrus reticulata*) was recorded as  $120.41 \pm 7.04$  g. The average peel percentage of orange was recorded as  $28.79 \pm 1.23$  % and juice content was recorded as  $47.14 \pm 2.54$  %. For standardization of multi-strain probiotic orange beverage three formulations were developed namely Formulation 1, Formulation 2, and Formulation 3. Each formulation contained 100% sterilized orange juice as per FSSAI, guidelines (2010). Formulation 1 (F1) was inoculated with 5.00 percentage *Lactobacillus bulgaricus* and 5.00 percentage *Lactobacillus casei*. Formulation 2 (F2) was inoculated with 3.33 percentage *Lactobacillus bulgaricus*, 3.33 percentage *Lactobacillus casei*, and 3.33 percentage *Lactobacillus gasseri*. Formulation 3 (F3) was inoculated with 2.50 percentage *Lactobacillus bulgaricus*, 2.50 percentage *Lactobacillus casei*, 2.50 percentage *Lactobacillus gasseri*, and 2.50 percentage *Lactobacillus fermentum*. Under each formulation two test samples were taken for incubating one test samples for 2hrs and the other test sample for 4hrs respectively. So from three formulations six test samples namely TS1 and TS2 (Formulation 1), TS3 and TS4 (Formulation 2), TS5 and TS6 (Formulation 3) were developed respectively. All the Test samples were subjected to sensory evaluation and based on the highest sensory scores Test Sample 1(TS1), Test Sample 3 (TS3) and Test Sample 5 (TS5) from Formulation 1, Formulation 2, and Formulation 3 were selected for further analysis. The selected test samples namely TS1, TS3, and TS5 were subjected to physico-chemical test, nutritional analysis, in-vitro hypocholesterolemic efficacy trial, in-vitro hypoglycemic efficacy trial and storage study. The physic-chemical results revealed that the control had a TSS of  $13 \pm 0.00^\circ$ Brix, whereas TSS of TS1, TS3, and TS5 was  $12^\circ$ Brix respectively. The TTA value of control, TS1, TS3, and TS5 were recorded as 0.40 %, 0.46 %, 0.45, and 0.50% respectively. The pH value of control, TS1, TS3, and TS5 were recorded as 4.14, 3.63,

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3.66, and 3.63 respectively. The results of nutritional analysis revealed that the moisture content of control, TS1, TS3 and TS5 were 94.17%, 92.70%, 92.70%, and 92.7% respectively. The carbohydrate content of control, TS1, TS3 and TS5 were 9.20 g/100g, 8.45 g/100g, 8.43 g/100g, and 8.45 g/100g respectively. The protein content of control, TS1, TS3 and TS5 were 0.4 g/100g, 0.35 g/100g, 0.35 g/100g, and 0.35 g/100g respectively. The fat content of control, TS1, TS3 and TS5 was 0.21 g/100g. The crude fiber content of control, TS1, TS3 and TS5 was 0.21 g/100g. The potassium content of control, TS1, TS3 and TS5 was 180mg/100g. Vitamin C content of control, TS1, TS3 and TS5 were 40.50mg/100ml, 38.28mg/100ml, 38.26mg/100ml, and 38.16mg/100ml respectively. The % DPPH free radical scavenging activity for the control sample was recorded as 54.25%, followed by TS5 (45.10%), TS3 (45.09%), and TS1 (42.17%) respectively. Test sample 1 (TS1) which was prepared using *Lactobacillus bulgaricus*, and *Lactobacillus casei* showed 25.80% of hypocholesterolemic activity, TS3 containing *Lactobacillus bulgaricus*, *Lactobacillus casei*, and *Lactobacillus gasseri* showed 26.92% hypocholesterolemic activity and TS5 which was prepared using *Lactobacillus bulgaricus*, *Lactobacillus casei*, *Lactobacillus gasseri* and *Lactobacillus fermentum* showed hypocholesterolemic activity of 27.65% respectively. The Test sample 1 (TS1) which was prepared using *Lactobacillus bulgaricus*, and *Lactobacillus casei* showed 50.85% of hypoglycemic activity, TS3 containing *Lactobacillus bulgaricus*, *Lactobacillus casei*, and *Lactobacillus gasseri* showed 54% hypoglycemic activity and TS5 which was prepared using *Lactobacillus bulgaricus*, *Lactobacillus casei*, *Lactobacillus gasseri* and *Lactobacillus fermentum* showed hypoglycemic activity of 55.78% respectively. The outcomes of the present study will be of great importance in addressing different disease causing factors like hypercholesterolemia and hypoglycemia, which are major predisposing factors of several non communicable diseases like CVD, diabetes, and several forms of cancers.

## **Development of micronutrient rich supplements from locally available foods**

*Ishita Nath*

The present study was undertaken with an aim of developing products from locally available greens and fruits which are easily available and affordable with potential nutritional benefits using household processing techniques. Therefore, the objectives of the study were decided to formulate products from locally available greens and fruits, to study overall acceptability of the developed products, to analyse the physico-chemical properties of the developed products and to study the shelf life of the developed products. Four formulations namely F1, F2, F3 and F4 were developed containing madhusuleng leaves, cauliflower leaves, amla and jaggery as main ingredients. Other ingredients were ghee, ginger, black pepper powder, clove powder and cinnamon powder. All the formulations were analyzed for physico-chemical properties in terms of pH, TSS, acidity, total sugar, reducing sugar, moisture, crude ash, crude protein, crude fiber, crude fat, carbohydrate, energy, antioxidant capacity, total phenolic content, total oxalate content, phytate content, tannin content and total flavonoid content along with storage stability in terms of pH, TSS, microbial load and sensory evaluation. Acceptability trials were conducted by trained and semi trained panel consisting of 15 members from Department of Food Science and Nutrition, Assam Agricultural University using nine-point hedonic scale. Data obtained from sensory, physico chemical analysis and storage study were subjected to completely randomized design to determine difference between treatment means by using ICAR WASP software. Result revealed that there was significant difference between the formulations in most of the parameters. The processing yield ranged from  $58.60 \pm 2.19$  to  $68.60 \pm 2.19$ . The pH of the developed product ranged from  $3.97 \pm 0.01$  to  $4.21 \pm 0.01$ , total soluble solid (TSS° Brix) from  $20.01 \pm 0.01$  to  $36.01 \pm 0.01$ , total titrable acidity (%) ranged from  $1.06 \pm 0.36$  to  $1.49 \pm 0.37$ , total sugar (%) from  $26.40 \pm 0.32$  to  $36.69 \pm 0.11$  and reducing sugar (%) ranged from  $15.24 \pm 0.19$  to  $27.15 \pm 0.18$ . The moisture content of the developed product ranged from  $41.67 \pm 0.52$  g/100g to  $52.16 \pm 0.11$  g/100g, crude fat content ranged from  $10.22 \pm 0.28$  g/100g to  $10.54 \pm 0.27$  g/100g, crude fibre content ranged from  $5.15 \pm 0.14$  g/100g to  $9.02 \pm 0.45$  g/100g, crude protein content ranged from

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1.23±0.01 g/100g to 1.90±0.02g/100g, total mineral content ranged from 2.30±0.05g/100g to 2.6±0.20g/100g, carbohydrate content ranged from 24.98±0.41 g/100g to 38.99±0.49 g/100g, energy ranged from 198.52±2.44 kcal/100g to 254.30±0.67 kcal/100g. The iron content ranged from 16.05±0.17 mg/100g to 20.97±0.08 mg/100g, calcium content ranged from 73.45±0.07 mg/100g to 105.54±0.13 mg/100g, zinc content ranged from 2.68±0.04 mg/100g to 2.79±0.06 mg/100g, magnesium content ranged from 9.11±0.10 mg/100g to 10.75±0.06 mg/100g and phosphorus content ranged from 42.78±0.14 mg/100g to 58.36±0.13 mg/100g. The antioxidant content of the developed product ranged from 72.14±0.28% to 80.10±0.40%, phenolic content (mg/100g) ranged from 32.02±0.01 to 40.02±0.01 and flavonoid content (mg/100g) ranged from 30.51±0.01 to 42.60±0.01. The phytate content (mg/100g) ranged from 2.88±0.02 to 3.77±0.02, oxalate content (mg/100g) ranged from 0.14±0.01 to 0.33±0.01 and tannin content (mg/100g) ranged from 0.44±0.01 to 0.60±0.01. The pH and TSS content of the formulations changed significantly ( $p \leq 0.05$ ) and there was significant increase ( $p \leq 0.05$ ) in the mean pH and TSS values across storage. The mean scores for bacterial and fungal load of the products stored in plastic airtight containers (PET) at refrigerated temperature changed significantly ( $p \leq 0.05$ ). At day 30, total fungal counts and total bacterial counts exceeded the acceptable limit of  $\leq 1000$  cfu/g and  $\leq 100000$  cfu/g (as per WHO guideline 1998) respectively, signaling the end of shelf-life of the products by 15 days. The mean scores of the sensory attributes of the formulations stored in plastic containers did not change significantly but there was a slight decrease in the scores across storage of 15 days. As the microbial limit exceeded on 30th day, sensory evaluation was not done on 30th day. From the findings it can be concluded that the developed products were made from locally available foods which were affordable foods and can be prepared using household processing techniques and has a good nutritional profile. The product may also be used for popularizing the formulations among the rural population as a source of nutritious foods.

## **Development and quality evaluation of hydrothermally treated rice from Kaoi Jamfri – a red kernel rice of Assam**

*Mandeep Digra*

The present study was undertaken with an aim of developing of hydrothermally treated rice from Kaoi Jamfri - red kernel rice of Assam having potential nutritional benefits. The objectives of the study were to optimize the process variables for developing hydrothermally treated red rice and to evaluate the quality of the developed hydrothermally treated red rice. In the present study, eighteen hydrothermally treated Kaoi Jamfri samples namely T1, T2, T3, T4, T5, T6, T7, T8, T9, T10, T11, T12, T13, T14, T15, T16, T17, and T18 coded as T1:2 (1h), T1:3 (1h), T1:4(1h), T1:2(3h), T1:3(3h), T1:4(3h), T1:2(6h), T1:3(6h), T1:4(6h), T1:2(9h), T1:3(9h), T1:4(9h), T1:2(12h), T1:3(12h), T1:4(12h), T1:2(24h), T1:3(24h) and T1:4(24h), respectively were developed with processing variables such as paddywater ratio (w/v) i.e., 1:2, 1:3 and 1:4 and different soaking times i.e. 1 h, 3 h, 6 h, 9 h, 12 h, and 24 h. For soaking of the paddy, boiled distilled water (100 °C) was used for all the samples followed by draining water and steaming at 15 psi (121°C) in vertical autoclave for 20 min and drying in tray drier till 11-13% moisture content. The untreated paddy sample was considered as control T0 coded as T0. All the samples were dehusked and polished (6%) and analysed for moisture content; milling qualities such as dehusked rice yield, polished rice yield, head rice yield, broken rice yield; physical characteristics such as length/ breadth ratio, 1000 grain weight, bulk density, color intensity, and texture; cooking qualities, such as water uptake ratio, cooking time, and grain elongation ratio; biochemical parameters such as DPPH radical scavenging activity, total anthocyanin content, amylose content and resistant starch. The hydrothermally treated cooked rice samples were evaluated for parameters by sensory evaluation conducted by ten trained and semi-trained panelists from the Department of Food Science and Nutrition, Assam Agricultural University using nine-point hedonic scale. Data obtained from moisture, milling, physical, cooking and biochemical analysis were subjected to completely randomized design to determine differences between developed hydrothermally treated

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Kaoli Jamfri rice samples means by using ICAR WASP software. The moisture content of samples before soaking were found to be similar ( $p \geq 0.05$ ), after soaking and drying ranged from  $20.21 \pm 0.09\%$  in T2 to  $41.71 \pm 0.09\%$  in T18 and  $11.95 \pm 0.47\%$  in T8 to  $13.98 \pm 0.15\%$  in T5 respectively. The dehusked and polished rice yield of hydrothermally treated rice samples ranged from  $72.70 \pm 0.16\%$  in T0 to  $77.55 \pm 0.30\%$  in T18 and  $66.73 \pm 0.18\%$  in T0 to  $71.39 \pm 0.37\%$  in T17 respectively. The head and broken rice yield of hydrothermally treated rice samples ranged from  $54.31 \pm 0.41\%$  in T0 to  $96.79 \pm 0.85\%$  in T15 and  $2.12 \pm 0.10\%$  in T18 to  $814.92 \pm 0.14\%$  in T0 respectively. The length/ breadth ratio of the hydrothermally treated rice samples were statistically similar ( $p \geq 0.05$ ), 1000 grains weight samples ranged from  $13.23 \pm 0.06\text{g}$  in T0 to  $18.77 \pm 0.03\text{g}$  in T18, bulk density ranged from  $0.77 \pm 0.05 \text{ g/ml}$  in T0 to  $0.88 \pm 0.05\text{g/ml}$  in T8, colour intensity ranged from  $30.05 \pm 0.02$  in T6 to  $39.11 \pm 0.04$  in T0. The hardness of the hydrothermally treated cooked rice samples were found to be similar ( $p \geq 0.05$ ). The water uptake ratio of the hydrothermally treated rice samples ranged from  $2.72 \pm 0.07$  in T0 to  $3.04 \pm 0.02$  in T18, cooking time ranged from  $20.45 \pm 0.60 \text{ min}$  in T18 to  $33.23 \pm 0.62 \text{ min}$  in T0, and elongation ratio among the samples were found to be non-significant ( $p > 0.05$ ). The DPPH radical scavenging activity (%) of hydrothermally treated uncooked and cooked rice samples ranged from  $14.42 \pm 0.07$  in T18 to  $24.23 \pm 0.51$  in T0 and  $6.48 \pm 0.12$  in T0 to  $7.37 \pm 0.16$  in T17 respectively. The total anthocyanin content of hydrothermally treated uncooked and cooked rice samples ranged from  $0.68 \pm 0.03 \text{ mg/100g}$  in T18 to  $5.96 \pm 0.11\text{mg/100g}$  in T0 and  $0.45 \pm 0.06 \text{ mg/100g}$  in T18 to  $1.74 \pm 0.06 \text{ mg/100g}$  in T0 respectively. The amylose content of hydrothermally treated uncooked and cooked rice samples ranged from  $21.17 \pm 0.34 \text{ g/100g}$  in T0 to  $27.39 \pm 0.24 \text{ g/100g}$  in T18 and  $18.97 \pm 0.48 \text{ g/100g}$  in T0 to  $26.99 \pm 0.06 \text{ g/100g}$  in T18 respectively. The resistant starch of hydrothermally treated uncooked and cooked rice samples ranged from  $12.04 \pm 0.07 \text{ g/100g}$  in T0 to  $27.46 \pm 0.36 \text{ g/100g}$  in T17 and  $6.20 \pm 0.09 \text{ g/100g}$  in T0 to  $23.34 \pm 0.08 \text{ g/100g}$  in T18 respectively. From the findings it can be concluded that hydrothermally treated Kaoli Jamfri have better milling qualities with increased head rice yield, reduced cooking time and improved resistant starch content. Resistant starch plays an essential role in decreasing postprandial hyperglycemia and thus hydrothermally treated Kaoli Jamfri can provide a better food option for people suffering from diabetes mellitus.

## **Effect of processing on antioxidant potential and antidiabetic activity of *Cajanus cajan* (L.) tender leaves**

*Meghna Borgohain*

The present study was undertaken with an aim to assess the effect of processing on antioxidant potential and antidiabetic activity of *Cajanus cajan* (L.) tender leaves. A series of laboratory experiments were carried out to study the physico-chemical properties of the raw and the processed leaves. The optimization of the processing technique for *Cajanus cajan* (L.) tender leaves were done in two techniques viz. drying and cooking techniques. Under drying treatments, shade drying and oven drying whereas in cooking, techniques like boiling, steaming, microwaving and stir frying were selected. In each technique, two treatments (T1 and T2) with varied time and temperature were taken. The shade dried sample showed the highest moisture (8.66%), fat (2.54g/100g), carbohydrate (49.35g/100g) crude fiber (8.12 g/100g) as compared to the oven dried sample. Fat content was observed the highest in the shade dried samples (2.54 g/100g), the raw leaves had lower fat content (1.71 g/100g). The carbohydrate content of the raw and the dried leaves ranged from 24.11 to 36.99 g/100g, the oven dried showed higher carbohydrate content and the lowest carbohydrate content was observed in the raw leaves. The energy content of the raw and the dried samples ranged from 175 to 342 kcal. The shade dried showed higher energy content (342 kcal) and the raw leaves showed the lowest energy content (175 kcal). The significant changes in dietary fibre content was found and the oven dried showed highest dietary fiber content (20.28 g/100g). The ash content was higher in the shade dried samples (11.21 g/100g), than the raw leaves (6.31 g/100g). The boiled sample showed higher moisture content (52.73%) compared to the other cooking techniques. The steamed sample showed the lowest protein content (12.77 g/100g), T The stir-fried sample showed the highest fat content (5.02 g/100g) as compared to the raw and other cooking techniques adopted. The fat content ranged from 5.02 g/100g (stir-fried) and 0.84 g/100g (boiled samples). The microwaved samples contained the highest carbohydrate content (71.05 g/100g) and the boiled sample showed the lowest carbohydrate content (26.04 g/100g). The highest

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energy content of 391.08 kcal was observed in stir-fried leaves while lowest was found in boiled (156 .00 kcal). The crude fiber content among the dried samples ranged from 4.71 to 8.12 g/100g. The boiled leaves showed highest dietary fibre content (24.53 g/100g) while the stir-fried sample showed the lowest dietary fibre content (21.05g/100g). The preliminary phytochemicals screening reveals that both raw and processed samples contain, phenol, tannins, flavonoids, saponins and alkaloids, however, 8 steroids and glycosides were not present in any of the samples. The Total Phenolic Content and The Total Flavonoid content were found highest in the oven dried sample 246.14 mg GAE/100g and 53.89mg QE/100g while compared to raw. The Total Phenolic Content and Total Flavonoid Content was found highest in the steamed sample (235.15mg GAE/100g and 41.42mg QE/100g) while compared to raw while lowest was found in boiled (220.07 mg GAE/100g and 31.09±0.21 mg QE/100g). Two solvents were used to extract samples and analysis of antioxidant and antidiabetic activities. The total antioxidant activity of the raw sample by methanolic and ethyl acetate extract were 85.74 per cent and 87.21per cent respectively, while the shade dried showed the highest antioxidant activity both in methanolic (45.12%) and ethyl acetate extracts (47.34%). The total antioxidant activity was observed highest in the steamed sample (85.25 %). The inhibitory activity of  $\alpha$ -amylase by methanolic extract showed the highest as compared to the ethyl acetate. The highest inhibition was shown by the raw leaves in both the extracts for  $\alpha$ -amylase (96.79% in methanolic and 92.15% in ethyl acetate) which reduced to inhibition percentage after drying. Oven dried samples showed higher  $\alpha$ -amylase inhibition (86.54 % in methanolic and 83.51% in ethyl acetate) and  $\alpha$ -glucosidase (75.23% in methanol and 72.11%in ethyl acetate) compared to the shade dried. Among the drying techniques adopted i.e shade drying and oven drying, the per cent inhibition of  $\alpha$ -amylase was found high in oven dried methanolic extract of *Cajanus cajan* (L) tender leaves with a IC50 values 31.07  $\mu$ g/ml. For the  $\alpha$ -glucosidase inhibition, from different drying treatments adopted, the oven dried sample lower (20.06  $\mu$ g/ml) IC50 compared to shade dried (23.06  $\mu$ g/ml) by methanolic extracts. Among the cooking techniques, steamed sample showed highest  $\alpha$ -amylase inhibition (80.14% in methanolic and 71.24 % in ethyl acetate) and the  $\alpha$ - glucosidase (70.08% in methanolic and 64.27% in ethyl acetate) with the IC50 values ranged from 34.02 to 41.35  $\mu$ g/ml by methanolic and 40.27 to 55.19  $\mu$ g/ml by ethyl acetate extract. A strong positive correlation between TPC and TFC (0.96), antioxidant activity (0.98), and  $\alpha$ amylase activities inhibited by methanolic extract (0.98) were observed. However, there was weaker correlation exhibited in the  $\alpha$ -glucosidase and TPC and also with  $\alpha$ -amylase. It is evident from the present study that the optimized drying and cooking techniques which exhibited better nutritional potential in terms of antioxidant and antidiabetic can be used to ensure better option for prevention and management of diabetes mellitus.



## **Development of value added cookies incorporating Perilla frutescens seeds**

*Oinam Latasha Devi*

The present investigation was undertaken with an aim to develop value added cookies incorporating *Perilla frutescens* seed and soya flour and to study the physicochemical, sensory and shelf life across the storage of developed cookies. Three composite flours were prepared using refined wheat flour, black rice flour and corn flour replacing with 5, 10 and 15 per cent perilla seed powder and 10 per cent soya flour and standardization of cookies were done in various trials. Ten different types of cookies including Control (100% wheat flour), WT1 (85:5:10), WT2 (80:10:10), WT3 (75:15:10), BT1 (85:5:10), BT2 (80:10:10), BT3 (75:15:10), CT1 (85:5:10), CT2 (80:10:10) and CT3 (75:15:10) were made a series of laboratory experiments were carried out to find the nutritional properties of developed cookies in terms of physical and chemical analysis. The physical properties of developed cookies indicated that weight ranged from 9.09 to 13.17g, diameter ranges from 37.93 to 47.47mm and thickness ranges from 8.63 to 11.86mm for individual cookies. Spread ratio was found between 4.00 to 4.38mm. The instrumental colour ranged from 42.93 to 82.19 towards lightness (L\*), 1.43 to 2.40 towards redness (a\*), 7.99 to 21.37 towards yellowness (b\*). Texture profile analysis of developed cookies in terms of hardness ranged from 2031 to 10504 g/sec. The moisture content of the cookies ranged from 4.26 to 4.85g/ 100g. Chemical analysis of the developed product showed that the crude protein content ranged from 6.97 to 14.05g/100g, crude fat content ranged from 31 to 41.95g/100g. Crude fibre and ash content were found highest in CT3 i.e. 75:15:10 (CF: PSP: SF) and lowest in control (100g WF). The total antioxidant capacity was found highest in BT3 and lowest in control. The total carbohydrate content was highest in Control (56.07g/100g) and lowest in CT3 (31.08g/100g). Mineral composition (calcium, iron, phosphorus, magnesium and zinc) of developed cookies was higher in all the treatments as compared to control sample. To screen out the best treatment, sensory evaluation was carried out by using 9 point hedonic rating scale and treatment with 15 per cent perilla seed powder was adjudged as the best treatment. Out of 9 treatments, the three best scored cookies of each respective flour were selected for carrying out the shelf life study

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and fatty acid profile determination. The highest content of linolenic acid ( $\omega$ -3 PUFA) and linoleic acid ( $\omega$ -6 PUFA) was observed in BT3 (10.47 %) and (8.74%) respectively. The  $\omega$ -6/  $\omega$ -3 ratio was found decreasing in all the treatments as compared to control sample. Shelf life study was done by storing in HDPE packaging materials and air tight container in room temperature for 30 days. Free fatty acid content increased within 7 accepted limit in both air tight container and HDPE while peroxide values were increased in HDPE packaging material as compared to air tight container. The increased values were within the standard specified value i.e.10meq/kg oil (FSSAI, 2018). Microbiological study was conducted for 30 days using two different media, NA and PDA. The mean scores for bacterial and fungal load were under the limit given by WHO (1994) Thus, it can be concluded that value added cookies can be developed by incorporating perilla seed powder and soya flour with higher nutritional qualities.

## **Development of gluten- free functional rice bread**

*Pallabi Sarkar*

The present study was undertaken with an aim of developing gluten- free functional rice bread having nutritional benefits and potential option for gluten-intolerant population. Therefore, the objectives of the study were decided to formulate bread using gluten- free base ingredients, to study the overall acceptability of the developed products and to evaluate the physical and nutritional composition of the developed products. Rice flour was selected as major base ingredient along with oats flour and barley flour and were analysed for nutrient composition in terms moisture, crude protein, crude fat, total mineral, crude fibre, dietary fibre, total carbohydrates, physiological energy value, total starch and amylose. Nine formulations namely T1, T2, T3, T4, T5, T6, T7, T8 and T9 were developed using rice flour, oats flour and barley flour as base ingredients. Other ingredients used were sugar, yeast, salt, xanthan gum, refined oil and water. Two controls namely positive control (wheat based) and negative control (rice based) were also developed. All the formulations were analysed for physical properties in terms of colour, texture, specific volume and bread shape ratio and sensory evaluation. Acceptability trials were conducted by 15 trained and semitrained panelists from the Department of Food Science and Nutrition, Assam Agricultural University using nine- point hedonic scale. Three formulations namely, T7, T8 and T9 were selected based on their highest acceptability trial values and nonsignificant difference from the positive control and were analysed for nutrient composition in terms moisture, crude protein, crude fat, total mineral, crude fibre, dietary fibre, total carbohydrates and physiological energy value. Data obtained from sensory, physical and nutritional composition analysis were subjected to completely randomized design to determine difference between formulation means by using ICAR WASP software. Results revealed that there was significant difference between base ingredients and formulations in most of the parameters. The ranges of nutrients of base ingredients were, moisture  $6.66 \pm 0.18 \text{g}/100\text{g}$  to  $11.28 \pm 0.39 \text{g}/100\text{g}$ , crude protein  $10.27 \pm 0.39 \text{g}/100\text{g}$  to  $14.34 \pm 0.18 \text{g}/100\text{g}$ , crude fat  $1.74 \pm 0.22 \text{g}/100\text{g}$  to  $6.94 \pm 0.10 \text{g}/100\text{g}$ , total mineral  $0.62 \pm 0.20 \text{g}/100\text{g}$  to  $1.37 \pm 0.13 \text{g}/100\text{g}$ , crude fibre  $1.57 \pm 1.13 \text{g}/100\text{g}$  to  $2.42 \pm 0.47 \text{g}/100\text{g}$ , dietary fibre  $2.92 \pm 0.26 \text{g}/100\text{g}$  to  $16.03 \pm 0.39 \text{g}/100\text{g}$ , total carbohydrates  $68.70 \pm 0.28 \text{g}/100\text{g}$  to  $80.52 \pm 2.73 \text{g}/100\text{g}$ , physiological energy value

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354.24±2.08kcal/100g to 394.65±1.05kcal/100g, total starch 60.75±0.47g/100g to 68.97±0.21g/100g and amylose 14.52±0.70g/100g to 26.13±2.24g/100g. Colour parameter of crust of developed products, L\* value ranged from 54.55±0.36 to 72.38±0.16, a\* value ranged from 3.03±0.16 to 16.23±0.41, b\* value ranged from 22.32±0.55 to 36.02±0.43 and browning index (BI) ranged from 40.30±1.21 to 112.79±1.00. L\* value of crumb of developed products ranged from 67.55±0.07 to 79.37±0.11, a\* value ranged from 1.16±0.16 to 2.79±0.12, b\* value ranged from 16.40±0.25 to 18.40±0.15 and browning index (BI) ranged from 23.45±0.67 to 31.77±0.67. For texture, firmness value of the developed products ranged from 5.50±1.38 N to 35.27±4.87 N, specific volume ranged from 2.49±0.18 cm<sup>3</sup>/g to 4.69±0.13 cm<sup>3</sup>/g and bread shape ratio ranged from 0.51±0.02 to 0.85±0.02. The ranges of nutrients of selected developed products were, moisture 32.86±0.66g/100g to 47.36±0.51g/100g, crude protein 10.76±0.48g/100g to 11.94±0.51g/100g, crude fat 3.36±0.15g/100g to 4.02±0.37g/100g, total mineral 0.25±0.02g/100g to 0.88±0.06g/100g, crude fibre 1.39±0.32g/100g to 1.90±0.25g/100g, total dietary fibre 4.70±0.15g/100g to 7.98±0.46g/100g, total carbohydrates 35.21±0.08g/100g to 53.56±0.49g/100g and physiological energy value 228.21±0.67kcal/100g to 284.42±0.89kcal/100g. From the findings it can be concluded that the products developed using rice flour, oats flour and barley flour has a good nutritional profile and could be a healthy option for the gluten- intolerant population as well as a source of nutritious gluten- free product.

## **Assessment of nutritional status of Karbi adolescent girls from Diphu, Assam**

*Puspa Khakhlary*

The present investigation was an attempt to assess the nutritional status of Karbi adolescent girls from Diphu, Assam. The specific objective of the study was to assess the nutritional status of target group through anthropometric indices, food and nutrient intake pattern and to evaluate with clinical parameters. A purposive random sampling was carried out to select 200 adolescent girls corresponding to the age group 13-15 years from 4 high schools of Diphu namely Mount Calvary English High School, Chandra Singh Teron High School, Don Bosco High School, Badan Memorial English High School. Anthropometric measurements revealed that majority of the adolescent girls were significantly lower than ICMR standard and NCHS standard with respect to height. According to Waterlow's classification of height-for-age majority of the Karbi adolescent girls (13 and 14 years) falls under normal nutritional status and in age 15 years, 52% were under marginal malnutrition. According to WHO (2007) Z scores of height for age observed majority of stunting in the age 13 years. The weight measurement revealed that the mean weight of 13-15 years were significantly lower than ICMR and NCHS standards. According to Gomez classification (weight for age), majority of the adolescent girls (13 and 15 years) falls under normal category and in the age 14 years, 41.77% were under mild malnutrition. According to World Health Organization (WHO, 2007) Z-score of BMI-for-age, majority of the study population between the age group of 13-15 years were normal (61.47% to 74.52%), the prevalence of thinness ranged from 3.92 to 21.42 and the prevalence of overweight and obesity ranged from 5.71-11.76% and 1.4-6.33% respectively. Garrow's BMI classification concluded that 35.71% in the age group of 13 years had severe chronic deficiency, whereas in the age group of 14 years, 29.11% had normal BMI for age, which was the highest percentage in the target group. In 15 years, 25.49% had low weight normal. The waist-hip ratio of Karbi adolescent girls was slightly higher than normal range ( $\leq 0.80$ ). There was a significant positive correlation observed between fat intake and weight of the target adolescent girls. Food habits revealed that cent percent of the target adolescent girls were non-vegetarian. The meal pattern of the respondents reflected that the majority of the girls had three main meals a day namely breakfast, lunch, and dinner

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with two mid snacks namely breaktime (tiffin time) and evening snacks. The frequency of consumption of food groups revealed that cereals, pulses, fats and oils and sugar and jaggery were consumed by all 13-15 years of age group. The consumption of other vegetables, roots and tubers, meat, fish and poultry were quite frequent in comparison to green leafy vegetables, fruits and milk and milk products. The average daily intake of cereal, pulses, roots and tuber, fats and oils, sugar and jaggery, meat, fish, poultry was fulfilled upto 70-90% of balanced diet recommended (BDR). The intake of other vegetables was fulfilled upto 60% of the BDR. On the other hand the mean daily of green leafy vegetables, milk and milk products and fruits were found to be 40-50% of BDR. The inadequate consumption of green leafy vegetables, milk and milk products and fruits leads to the deficiency of important vitamin and minerals which in turn may affect growth and development of the adolescent girls. The Frequency of consumption of fast foods was once to thrice per week. Clinical signs and symptoms of adolescent girls revealed the deficiency in nutrient intake of iron, vitamin C and beta-carotene.

## **Development and quality evaluation of nutri-dense pancake mix**

*Taposhi Thakuria*

The present study was undertaken to formulate a nutri-dense pancake mix with an aim of enhancing the nutritive value of the traditionally prepared rice based pancake in Assam. Therefore, the objectives of the study were formulation of nutridense pancake mixes, physico-chemical analysis of the developed nutri-dense pancake mixes and storage study of the developed nutri-dense pancake mixes. Twelve formulations of nutri-dense pancake mixes were developed where the principle ingredient, i.e., rice flour was partially substituted with soybean flour (*Glycine max*), amaranth seed flour (*Amaranthus cruentus*), mushroom flour (*Pleurotus ostreatus*) and garden cress seed flour (*Lepidium sativum*) into three different sets. Each set contained four variations viz. PM with mushroom flour [PM1 (50:10:35:5), PM2 (50:10:30:10), PM3 (50:10:25:15) and PM4 (50:10:20:20)], PG with garden cress seed flour (*Lepidium sativum*) [PG1 (50:10:35:5), PG2 (50:10:30:10), PG3 (50:10:25:15) and PG4 (50:10:20:20)] and PMG with combination of mushroom flour and garden cress seed flour [PMG1 (50:10:30:5:5), PMG2 (50:10:20:10:10), PMG3 (50:10:20:15:5) and PMG4 (50:10:20:5:15)]. The developed formulations were subjected to sensory evaluation conducted by 10 trained and semi-trained panelists from the Department of Food Science and Nutrition, College of Community Science, Assam Agricultural University using nine-point hedonic scale. From the three group, the most acceptable variation was selected for further analysis of physico-chemical analysis, mineral contents in terms of calcium and iron and storage stability. Data obtained were subjected to completely randomized design to determine difference between treatment means by using ICAR WASP software. Colour parameter in terms of L\* values ranged from  $39.12 \pm 0.64$  to  $80.92 \pm 0.28$ , a\* values ranged from  $0.70 \pm 0.04$  to  $5.55 \pm 0.04$ , b\* values ranged from  $2.51 \pm 0.17$  to  $17.1 \pm 0.48$ , hue values ranged from  $24.33 \pm 0.45$  to  $85.76 \pm 7.61$  and chroma values ranged from  $11.85 \pm 0.19$  to  $293.96 \pm 3.46$  in control, PM1, PG1 and PMG2. Physical parameters such as weight ranged from  $53.00 \pm 2.29$ g to  $53.83 \pm 1.61$ g, diameter ranged from  $12.17 \pm 0.58$ cm to  $12.33 \pm 0.47$ cm, thickness ranged from  $34.00 \pm 1.00$ mm to  $40.00 \pm 1.00$ mm and spread ratio ranged from  $3.05 \pm 0.23$  to  $3.61 \pm 0.28$  among control, PM1, PG1 and PMG2. The moisture content of the developed pancake mixes ranged from  $9.38 \pm 0.02\%$  to  $11.06 \pm$

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0.20%, energy content ranged from  $255.39 \pm 7.65$  Kcal/100g to  $359.79 \pm 1.31$  Kcal/100g, crude protein content ranged from  $12.80 \pm 0.03$  g/100g to  $16.93 \pm 0.03$  g/100g, crude fat content ranged from  $1.24 \pm 0.12$  g/100g to  $6.69 \pm 0.01$  g/100g, crude fibre content ranged from  $1.59 \pm 0.03$  g/100g to  $3.48 \pm 0.02$  g/100g, carbohydrate content ranged from  $62.47 \pm 0.08$  g/100g to  $80.02 \pm 0.39$  g/100g and ash content ranged from  $1.01 \pm 0.01$  g/100g to  $2.56 \pm 0.03$  g/100g. Functional properties such as bulk density ranged from  $1.54 \pm 0.002$  g/ml to  $1.70 \pm 0.002$  g/ml, water absorption capacity ranged from  $67.57 \pm 0.40\%$  to  $160.07 \pm 0.55\%$  and oil absorption capacity ranged from  $87.23 \pm 0.25\%$  to  $112.27 \pm 0.25\%$ . Calcium content ranged from  $15.64 \pm 0.56$  mg/100g to  $111.50 \pm 1.32$  mg/100g and iron content ranged from  $1.38 \pm 0.20$  mg/100g to  $16.4 \pm 0.33$  mg/100g. The moisture content, free fatty acid and peroxide value increased significantly from day 15 to day 30. The mean scores of microbial study of the nutrified pancake mixes stored in laminated aluminium foil zip lock pouches at refrigerated temperature of  $4^{\circ}\text{C}$  changed significantly ( $p \leq 0.05$ ) from 0th day to 30th day. It was observed that at day 30, the total bacterial counts exceeded the acceptable limit of  $\leq 100000$  cfu/g as per WHO guideline 1998 signaling the end of shelf-life of the product by day 15. The mean scores of the sensory attributes of the developed mixes did not change significantly but there was a slight decrease in sensory scores across storage of 15 days. As bacterial load exceeded on day 30, sensory evaluation was not done on day 30. From the findings of the study it can be concluded that the developed pancake mixes had good nutritional profile and can be popularized among the population as a source of nutritious food in the form of snack.



# **Impact of Reading Habits on the Academic Performance of Adolescents in Golaghat district of Assam**

*Arundhati Khound*

Reading should be a habit as it has an impact on an individual's intellectual and emotional development. Reading thoroughly will certainly increase an individual's chances of broadening their mental limits and being more successful in life. It is obvious that in today's competitive world, increased reading literacy is essential to obtain one's desired profession, manage one's home efficiently, and enjoy one's personal life. Reading also demonstrates the road that an individual may take to become a responsible citizen of the country. With this background the present study entitled, "Impact of Reading Habits on the Academic Performance of Adolescents in Golaghat district of Assam" was undertaken during the calendar year 2019-2021 with the objectives as- to explore the reading habits among adolescents, assess the reading strategies used by adolescents, assess the impact of reading habits on academic performance of adolescents and to find out the gender differences in the reading habits of adolescents. By using a multi-stage sampling procedure, a sample of 342 numbers of adolescents from eight schools of the East and South educational blocks of Golaghat district were drawn randomly from classes 9-12, considering the students belong to the age group of 15-19 years. A self-constructed questionnaire was prepared to collect the required information from all the respondents. The collected data were coded and analyzed using IBM SPSS. The findings revealed that the majority of the adolescents had the habit of reading books on a daily basis. It was also found that the majority of them spent 2-4 hours in reading course textbooks and class notes. When it came to reading materials, it was discovered that, the majority chose to read their course textbooks regularly, but they preferred to read other books only on weekends and holidays. The majority preferred to read printed materials, and majority had no subscription to any online reading site. A higher percentage of the adolescents in the study did not have the habit of reading newspapers regularly, but the majority of them used to read magazines. It was also found that intensive reading was the most common reading strategy adopted by adolescents. It was

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also revealed that there was no significant gender difference in the reading habits of adolescents. The findings also indicated that there was a positive correlation between the reading habits of adolescents and their academic performance. Their reading habits helped them to increase their knowledge, improve their vocabulary, writing, grammar, spelling mistakes, and enhance skills in everyday life.

## **Students' perception towards online school**

*Merina Machiya Deori*

Due to the COVID-19 pandemic, the worldwide education system has been severely affected, following the shutdown of schools, colleges and universities since March 2020. In order to prevent the spread of the virus, traditional classrooms shifted to online classrooms which profoundly impacted teachers' and students' close interaction, making a paradigm shift in the teaching-learning process. For students, the disparity is more evident, owing to the diverse socio-economic backgrounds and geographical locations that they come from. Some students, especially from the urban areas, are comfortable with the online classes because they have access to online learning opportunities, support and resources at their homes. However, the ones from the lower socio-economic background and rural areas are at a huge disadvantage, as they do not have access to proper online resources and adequate infrastructural support. Against such a backdrop, it is relevant to analyse the perception of students and the challenges of online classes during this ongoing COVID-19 outbreak. With this background the present study entitled, "Students' perception towards online school" was undertaken during the calendar year 2019-2022. By using stratified multistage sampling procedure, sample of 384 students from eight schools of the Tinsukia Urban and Hapjan blocks of Tinsukia district were drawn randomly from classes 1-10, both from government and private schools. A self-constructed questionnaire was prepared to elicit information from students regarding background information, perception regarding online school and challenges faced by students. The collected data were coded and analysed using IBM SPSS. By performing linear regression analysis, it was found that the contributing predictors of students' perception towards online school were interaction and participation, teacher conducting classes, perceived usefulness, academic performance and mode of class. It was found that although students found online classes useful for its flexibility and convenience but majority of the students preferred offline class over online class. It was also revealed that majority of the students found problems like internet connectivity, stress and anxiety, data limit and backache during online class. It was also depicted that there exists significant difference in problems of urban and rural students in technological barriers, accessibility and in mental health issues. Key words: Online school, Traditional learning method, Perception, Students.

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**Abstract of M.Sc. thesis**

**Department: Human Development and Family Studies**

**Major Adviser: Dr. Sampreety Gogoi**

## **Documentation and adaptation of motifs of Madhubani painting of Bihar to develop diversified products using hand printing techniques**

*Anima Mandal*

The present investigation was undertaken to study the “Documentation and adaptation of motifs of Madhubani painting of Bihar to develop diversified products using hand printing techniques”. The study was carried out in two districts i.e. Madhubani and Darbhanga. Altogether 143 respondents were selected as “Sample respondents” for the present study. Data were collected personally. Relevant statistical methods were employed to analyze the data. The study revealed that 60.18 percent of respondents belong to the 46-55 years age group, 70.80 percent were female, 42.48 percent were metric pass and 66.37 percent were local people practicing Madhubani painting. A total of fifty (50) motifs were collected and analyzed critically and out of these thirty six (36) motifs were selected for the development of ten (10) designs for apparel and home decor items using CorelDRAW X5. Cotton and silk fabrics were selected for the study, Pigment dye was used for printing using screen and block printing methods. Items such as bedsheets, wall hanging, stoles 1 and tablemat1 were selected for screen-printing, and items such as kurti, trousers, top, stoles 2, mask and tablemat2 were selected for block printing. Evaluation of constructed items was done on suitability, design features adapted, colour combination, motifs, placement of design and cost of the items prepared. Rank of prepared items was calculated and found that table mat 1 obtained 1st rank, Bedsheet obtained 2nd rank, Wall Hanging obtained 3rd rank, and Stoles 1 obtained 4th rank in screen printing. In block printed items stole 2 obtained 1st rank, Table mat 2 obtained 2nd rank, Top obtained 3rd rank, Trouser obtained 4th rank, Mask obtained 5th rank and Kurti obtained 6th rank. It was observed that the majority of the respondents found the price reasonable for all the garments, very few of the respondents found low price and high price of the constructed items.

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**Abstract of M.Sc. thesis**

**Department: Textiles and Apparel Designing**

**Major Adviser: Dr. Rickey Rani Boruah**

# **Designing Transformable Apparel For Women: A Sustainable Solution to Overconsumption of Clothing**

*Anjali Kaman*

The core of this research is the practical exploration of transformable apparel designs, which aims to create sustainable designs from an innovative perspective. This new design method, for a multi-purpose garment that can change its design and style, will reduce fabric waste to an extent by allowing the consumers to have dual benefits from a single purchase and engage them in sustainable practices. Transformable garments have a unique advantage that they can both attract consumers by their design and functions while also contributing to sustainable fashion. The present study on “Designing Transformable Apparel for women: A sustainable solution to overconsumption of clothing” was carried out with the following objectives: 1) To design Transformable Apparel for women, 2) To study the opinion of the respondents towards transformable apparel designs as a solution to over consumption of clothing. Questionnaire-I was prepared to find out the awareness of the respondents regarding transformable apparels and also to get an insight into their preferences and decision making process while purchasing a garment. Twelve(12) transformable garment designs were sketched out on A3 papers, using fashion illustration. Three (3) most preferred designs were selected in consultation with the major advisor and members of the advisory committee. Garments were constructed using printed and plain viscose-cotton blend fabrics. Questionnaire-II was prepared after the completion of construction of the transformable garments to take the opinions of the respondents on the stitched garments. Data was collected from 70 respondents from Jorhat and was tabulated and analyzed to conclude the study using appropriate statistical formula. From the data, it was found that Design No. A1a obtained the 1st rank and Design No. A1b and Design No. B1a obtained 2nd and 3rd rank, respectively. Design No. A2a and B2a obtained 4th and 5th rank followed by Design No. B2b in 6th rank and Design No. C2b got the 7th rank. High majority of the respondents, 94.2% would like to purchase transformable apparels.

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**Abstract of M.Sc. thesis**

**Department: Textiles and Apparel Designing**

**Major Adviser: Dr. Satvinder Kaur**

# **Evaluation of Ultra-Violet Protection Property of Cotton Fabric Dyed with Leaves of *Coffea Arabica* – A Natural Colourant**

*Banashree Handique*

Nature has given us a palette of colours that draw attention from all over the world to a vibrant planet. Natural dye offers us the advantages of eco-friendly dyeing and played an enormous significant role in our lives for thousands of years. They also provide us the benefits of antibacterial, antifungal, antioxidant as well as Ultraviolet protection. Mordants are crucial in creating a bridge between fibre and natural dye molecules because of their poor affinity that are distinguished by chemical and environmentally friendly agents. Natural dyes with Natural mordant are widely used in today's contexts to lessen environmental issues. The most significant foundation for inventive developments has come from textiles' protective properties. High-performance fabrics that are kind to the skin have become more well-known and significant in recent years. Due to the depletion of the stratospheric ozone layer and an increase in UV radiation on the earth's surface, the risk to human health is growing daily. The Ultra Violet blocking qualities of fabrics are strengthened when they are dyed or coloured. Using natural materials with natural pigments and fibres is a great way to limit UVB exposure. The current study entitled, "Evaluation of Ultra-violet protection property of Cotton fabric dyed with leaves of *Coffea arabica* – A Natural Colorant." was undertaken with the following objectives in mind: i. Optimization of dyeing parameters of selected dye on Cotton fabric. ii. Assessment of physical properties of selected fabric. iii. Evaluation of colour fastness properties of dyed fabric. iv. Analysis of Ultra Violet Protection property of dyed Fabric. For the study, Natural dye unused Coffee (*Coffea arabica*) leaves and Natural mordant Myrobalan (*Terminalia chebula*) were selected and collected from the Assam Agricultural University campus. The metallic mordant Alum ( $\text{AlK}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$ ), Stannous chloride ( $\text{SnCl}_2$ ), Ferrous sulphate ( $\text{FeSO}_4$ ) and copper sulphate ( $\text{CuSO}_4$ ) were selected. The cellulosic based cotton fabric was selected to carry out the dyeing process and were collected from the local market of Jorhat district. From the series of optimization, the 2% alkaline medium was optimized for extracting the leaves of coffee dye. The optimum dye extracting time was 60 minutes. The extraction

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**Abstract of M.Sc. thesis**

**Department: Textiles and Apparel Designing**

**Major Adviser: Dr. Nabaneeta Gogoi**

was used to colour cotton fabric and the optimum conditions were 2% dye at 70 for 60 minutes. The mordant concentration, mordanting time and mordanting methods were also optimized to get the better shades and dyeing condition. 7 Cream, Royal Ivory, Jasmine wisp- N, Sandal wood, Morning dream and Brandy colours were obtained from non-mordanted, myrobalan, alum, stannous chloride, ferrous sulphate and copper sulphate mordanted cotton fabric respectively. The control, non-mordanted and mordanted cotton fabrics were undergone for a series of physical experiments. The non-mordanted and different mordanted cotton fabrics were found to be increased in terms of fabric count (nos.), fabric thickness (mm), weight (GSM) and moisture regain (%) than control cotton fabric. The tensile strength (N), elongation (%), tearing strength (gm/cm), drapability (%), air permeability (cm<sup>3</sup> /cm/s) and crease recovery (angle) were found to be decreased in dyed cotton fabric as compared to control one. Ferrous sulphate and Copper sulphate mordanted fabric showed highest stiffness and Flexural rigidity in both warp and weft direction respectively. While myrobalan mordanted fabric displayed highest wicking height. Through a series of tests, colourfastness characteristic namely, colourfastness to sunlight, washing, crocking, pressing, and perspiration were assessed for dyed cotton fabric in terms of colour alteration. They demonstrated fair to good ratings, and there was little to no staining of the colour. The morphological, elemental, and structural characteristics of control and dyed fabrics were assessed using SEM, EDX, FTIR, and XRD analysis. SEM and EDX analysis were done to determine the surface morphology and elemental composition of the control and dyed cotton fabric and the differences in morphology and elements between them were clearly visible. FTIR analysis was used to identify the functional groups and various bonds that were present in the fabric and visible in different spectra. The crystallinity region of the fabrics was identified using XRD analysis, and alterations in the crystallinity structures of dyed cotton fabrics compared to control ones were discovered. Lastly but most crucially, the Ultra-violet protection properties of control, nonmordanted and different mordanted dyed cotton fabrics were evaluated and found that the Ultra-violet protection property were increased in dyed cotton fabric. The highest Ultra violet protection property was observed by copper sulphate mordanted cotton fabric followed by ferrous sulphate, stannous chloride, myrobalan, without mordant, alum and control cotton fabric. Though the Ultra-violet protection property was decreased in dyed fabric after 5th to 10th wash, but it was found to be retained in good to excellent ranges (>15, >40) of UV radiation.

## **Enzymatic extraction and processing of non-conventional fiber from betel nut (*Areca catechu*)**

*Debangana Priya Bora*

The search for efficient and green oxidation technologies has increased to replace the conventional non-biological methods. In the present investigation an efforts have been made to treat the areca husk fiber with cellulose enzyme as a suitable and eco-friendly alternative to chemical processing for achieving desired softness in areca husk fiber. Enzymes treatment removed the protruding hairs on the surface, enhances the water absorbency and also makes the fiber more soften. Among the different existing enzymes, cellulase have been using intensively in textile industry due to their advantageous property. Cellulase enzymes have become an efficient tool for finishing. Moreover, this enzyme can be used to modify the surface properties of the fiber. Utilization of agro waste material is an important means to conserve the environment from dumping large quantity in to bare lands and it also helps in new innovative product development from low cost materials. In the present study, well matured areca nut husk were collected in large quantities and the fiber was extracted by water retting method. Extracted fibers were treated with two cellulase enzymes (acid cellulase and cellulase).The physical, chemical and mechanical properties of treated and untreated areca nut husk fiber were studied. The fiber shows good cellulase and hemicelluloses content and little amount of ash and wax content. The surface morphology is examined with the help of SEM at various magnifications. Fiber is found to be shorter in length and has good strength properties. Moisture and density of the fiber is also analyzed. After that both the enzyme treated and raw areca nut husk fiber processed for composite board preparation. The prepared composite boards were tested for various performance properties. It was found that after the enzyme treatment, physical properties such as moisture regain, fiber diameter, water absorbency, wicking height etc and mechanical properties viz., elongation, density and surface characteristics were improved as compared to untreated fiber. Moreover, enzyme treated fiber reinforced composite board also provide higher physical and mechanical property as compared to untreated fiber reinforced composite board. This can be concluded from the study that the prepared composite board made of areca husk fibers is suitable for interior use as well as furnishing products and sports equipment.

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**Abstract of M.Sc. thesis**

**Department: Textiles and Apparel Designing**

**Major Adviser: Dr. Binita B. Kalita**



# **Resurgence of Traditional Assamese Motifs: Their Application in Contemporary Indian Women's Wear**

*Dristirupa Nath*

The present study on “Resurgence of Traditional Assamese Motifs: Their Application in Contemporary Indian Women's Wear” was carried out with the following objectives 1. To design and develop different yoke styles for women's kurtis, 2. To select suitable traditional Assamese motifs for the yokes, 3. To develop the yokes and construct kurtis using the developed yokes, 4. To take the opinion of respondents on the constructed kurtis. Fifteen (15) yoke styles were sketched and among them seven (7) yoke styles were selected in consultation with the major advisor. The traditional Assamese motifs were collected from various primary and secondary sources and seven (7) traditional Assamese motifs were selected in consultation with the major advisor. The motifs were developed manually on individual sheets of graph paper. Then the selected seven (7) yoke styles and seven (7) traditional Assamese motifs were evaluated visually by 50 respondents of Assam Agricultural University, Jorhat. The respondents were asked to give their order of preferences regarding Yoke styles (shape of the yoke) suitable for using traditional Assamese motifs and Traditional Assamese motifs suitable for use on yoke through schedule I. The data was collected using the rating sheets and final three (3) yoke styles and three (3) motifs were short listed for the study. The motifs were placed differently for the different yoke styles. Total nine (9) yokes (3 yoke styles × 3 motifs) were developed on graph paper and woven on handloom. Greenish yellow and green coloured yarns were selected for the yoke and yellow coloured fabric was selected for the kurti. These three colours belong to the analogous colour scheme. Polyester yarn of count number 60/2 locally called padmini was used for weaving of the yokes. After weaving, yoke shapes were cut and finished with a bias binding. For construction of kurtis, a girl of 34 inch (85 cm) bust measurement was selected as a model and her measurements were taken for construction of the basic bodice block. Nine (9) kurtis with the developed hand woven yokes were stitched using plain weave lizzy bizzy fabric. The kurtis were constructed by following proper methods of economical layout, cutting and stitching. The constructed kurtis were then displayed and

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**Major Adviser: Dr. Satvinder Kaur**

data was collected using the interview schedule II prepared for the purpose. Number of respondents was 50 women from Assam Agricultural University, Jorhat. As per data from the interview schedule I, Yoke No. 1 got rank 1, Yoke No. 4 got rank 2 and Yoke No. 2 got rank 3 and these were selected for developing the designs further. Findings also highlighted that Motif No. 5 obtained rank 1, Motif No. 2 obtained rank 2 and Motif No. 6 obtained rank 3 and these were selected for developing the patterns for the selected yoke styles. Data from interview schedule II revealed that majority of the respondents found all the yoke styles as excellent. None of the respondents found the yoke styles as poor. Regarding overall appearance of the constructed kurtis with hand woven yoke, all the kurtis were preferred by majority of the respondents. It was observed that majority of the respondents found the cost of the kurti in all the forms as reasonable. A few of the respondents found it as fair and very few of the respondents found it as expensive. The findings also showed that Kurti Design No. 1 obtained 1st rank, Kurti Design no. 6 obtained 2nd rank and Kurti Design No. 5 obtained 3rd rank. It was found that Kurti Design No. 2 got 4th rank and Kurti Design No. 3 got 5th rank. Kurti Design No. 4, Kurti Design No. 7, Kurti Design No. 8 and Kurti Design No. 9 got the rank 6th, 7th 8 th and 9th respectively. Data also revealed that high majority of the respondents would like to buy the yoke pieces/yokes/kurtis whereas very few of the respondents did not want to buy the yoke pieces/yokes/kurtis. It was found that half of the total respondents would like to buy stitched kurti, very few respondents wanted to buy only the woven fabric pieces and yoke with strips for sleeves.

## **A study on the Costumes of Meghalaya with special preference to Jaintia tribe**

*Hosanna Sumer*

A Study on traditional costume of Meghalaya with special preference to the was conducted for the present study. The current research took place in~Jaintia Tribe Jaintia Hills District of Meghalaya. There are two sub-division in jaintia hills district; west and east of jaintia. Both of this division where chosen purposely for the researches work. A random sampling as well as the multistage method had been adopted to conduct this study. For this study three main villages were selected from both the east and the west district. From the west district Jowai, Nartiang, and Mihmyntdu were selected and from the east Khliehriat, wapung, and Ladrymbai village were selected. From the selected villages of the west district 30 samples were selected from Jowai, 10 samples from Nartiang, and 10 samples from Mihmyntdu, and from the east district 30 samples were selected from Khliehriat,10 samples from Wapung and 10 samples from Ladrymbai, and the total of 100 samples ware selected. Selected respondents were asked to answer the questions given in the questionnaire. In this case three generation were selected for the study i.e. from the grand parent, parent, and children of both male and female. To get a clear interpretation of the picture of the costumes worn by both male and female of the three generation i.e., the grand parent, parent, and children. It was divided into six categories on the basis of their sex which is given below; 1. Grand parent Group I - (a) Grand father (b) Grand mother 2. Parent Group II – (a) Father (b) Mother 3. Children Group III- (a) Son (b) Daughter The traditional dresses of the Jaintia males are yuslien, ka kamasa, putoi, sulapoh, yuspong, thad tawah ryndia tlem, and dresses used by the females are yusem thoh khyrwang, sari, ki yusem dhara, ki yusem nara, ki yusem muka, blouse, ki yusem thoh saru, ki yusem ryndia, thad kup Merina. The changes in these traditional costumes of both male and female from one generation to another has been notice in this study. Through this study we have seen the people’s way of life and adaptation and the documentation of the costume used by them, their weaving and its speciality will be of a great help to the future generations to learn more about the Jaintia tribes of Meghalaya and their existences, and also for the purpose of preserving their culture and traditional costumes.

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**Abstract of M.Sc. thesis**

**Department: Textiles and Apparel Designing**

**Major Adviser: Dr. Ava Rani Phukan**

## **An Empirical Study on Profile of Handlooms of Jorhat District of Assam**

*Milan Saikia*

The present study on “Resurgence of Traditional Assamese Motifs: Their Application in Contemporary Indian Women’s Wear” was carried out with the following objectives 1. To design and develop different yoke styles for women’s kurtis, 2. To select suitable traditional Assamese motifs for the yokes, 3. To develop the yokes and construct kurtis using the developed yokes, 4. To take the opinion of respondents on the constructed kurtis. Fifteen (15) yoke styles were sketched and among them seven (7) yoke styles were selected in consultation with the major advisor. The traditional Assamese motifs were collected from various primary and secondary sources and seven (7) traditional Assamese motifs were selected in consultation with the major advisor. The motifs were developed manually on individual sheets of graph paper. Then the selected seven (7) yoke styles and seven (7) traditional Assamese motifs were evaluated visually by 50 respondents of Assam Agricultural University, Jorhat. The respondents were asked to give their order of preferences regarding Yoke styles (shape of the yoke) suitable for using traditional Assamese motifs and Traditional Assamese motifs suitable for use on yoke through schedule I. The data was collected using the rating sheets and final three (3) yoke styles and three (3) motifs were short listed for the study. The motifs were placed differently for the different yoke styles. Total nine (9) yokes (3 yoke styles × 3 motifs) were developed on graph paper and woven on handloom. Greenish yellow and green coloured yarns were selected for the yoke and yellow coloured fabric was selected for the kurti. These three colours belong to the analogous colour scheme. Polyester yarn of count number 60/2 locally called padmini was used for weaving of the yokes. After weaving, yoke shapes were cut and finished with a bias binding. For construction of kurtis, a girl of 34 inch (85 cm) bust measurement was selected as a model and her measurements were taken for construction of the basic bodice block. Nine (9) kurtis with the developed hand woven yokes were stitched using plain weave lizzy bizzy fabric. The kurtis were constructed by following proper methods of economical layout, cutting and stitching. The constructed kurtis were then displayed and data was collected using the interview schedule II prepared for the purpose. Number of

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**Abstract of M.Sc. thesis**

**Department: Textiles and Apparel Designing**

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respondents was 50 women from Assam Agricultural University, Jorhat. As per data from the interview schedule I, Yoke No. 1 got rank 1, Yoke No. 4 got rank 2 and Yoke No. 2 got rank 3 and these were selected for developing the designs further. Findings also highlighted that Motif No. 5 obtained rank 1, Motif No. 2 obtained rank 2 and Motif No. 6 obtained rank 3 and these were selected for developing the patterns for the selected yoke styles. Data from interview schedule II revealed that majority of the respondents found all the yoke styles as excellent. None of the respondents found the yoke styles as poor. Regarding overall appearance of the constructed kurtis with hand woven yoke, all the kurtis were preferred by majority of the respondents. It was observed that majority of the respondents found the cost of the kurti in all the forms as reasonable. A few of the respondents found it as fair and very few of the respondents found it as expensive. The findings also showed that Kurti Design No. 1 obtained 1st rank, Kurti Design no. 6 obtained 2nd rank and Kurti Design No. 5 obtained 3rd rank. It was found that Kurti Design No. 2 got 4th rank and Kurti Design No. 3 got 5th rank. Kurti Design No. 4, Kurti Design No. 7, Kurti Design No. 8 and Kurti Design No. 9 got the rank 6th, 7th 8 th and 9th respectively. Data also revealed that high majority of the respondents would like to buy the yoke pieces/yokes/kurtis whereas very few of the respondents did not want to buy the yoke pieces/yokes/kurtis. It was found that half of the total respondents would like to buy stitched kurti, very few respondents wanted to buy only the woven fabric pieces and yoke with strips for sleeves.

## **Study the effect of natural mordants on eco-friendly dyeing of eri matka silk of Manipur with bark of mango (*Mangifera indica*) tree**

*Ngangbam Vedamani Chanu*

Natural dyes are used in the textile colouration over the world due to their properties of renewable, non-toxic, biodegradable and eco-friendly nature to the environment. In recent years, natural mordants are widely use in dyeing with natural dyes as the metallic mordants are not always eco-friendly in use of textiles. Natural mordants contain tannin, catechin and other compound which can be use in the colouration of textile. Considering the importance of natural mordant with natural dye and eri matka silk of Manipur, the present research work was conducted on, “Study the effect of natural mordants on eco-friendly dyeing of eri matka silk of Manipur with bark of mango (*Mangifera indica*) tree” with the following objectives: To optimize the dyeing parameters of selected dye on eri matka silk. • To study the effect of natural mordants on colourfastness properties of natural • dyes. To study the physical properties of eri matka silk before and after dyeing. • Eri matka silk yarns were collected from Sangaithel, Imphal West district of Manipur for the study. Mango bark dye were selected after pre testing and three mordants viz., myrobalan (*Terminalia chebula*) and tea leaves (*Camellia sinensis*) as natural mordants and alum as a metallic mordant were used to compared with natural mordants for the study. Mango bark and natural mordants were collected from Assam Agricultural University campus. The dyeing conditions namely extraction medium, extraction time, dye material concentration, dyeing time, mordanting concentration, mordanting time and mordanting methods (pre, simultaneous and post) were optimized. Dyeing of eri matka silk yarn with mango bark dye and in presence of three mordants i.e, alum, tea leaves and myrobalan produced different shades of yellow-orange and brown colour i.e., yellow ochre, cadmium deep yellow, tawny gold and dark raw sienna colour etc. Evaluation of colourfastness properties of eri matka silk dyed yarn with selected dye was carried out in a series of experiment such as fastness against sunlight, washing, crocking (dry and wet), perspiration (acidic and alkaline) and pressing (dry and wet), which exhibited fair to good ratings with slightly to

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**Abstract of M.Sc. thesis**

**Department: Textiles and Apparel Designing**

**Major Adviser: Dr. Nabaneeta Gogoi**

negligible stained. 7 CIE lab and colour strength (K/S) of dyed yarns were also evaluated and observed that myrobalan mordanted yarn obtained the greater depth of colour and alum mordanted yarn found the lowest depth of colour among the mordanted dyed yarn. The positive values of  $a^*$  and  $b^*$  indicated the redness and yellowness present in the dyed yarn. For colour strength (K/S), myrobalan mordanted dyed yarn obtained highest (K/S) value and lowest (K/S) value in alum mordanted yarn. Raw and dyed yarns were evaluated for their morphological as well as structural properties through FTIR and SEM. FTIR was carried out to determine the presence of different functional group before and after dyeing and observed the difference of spectrum in the raw and dyed eri silk yarn. SEM analysis was done to determine the structure of the fiber before and after dyeing and observed dyed eri matka silk seems to be more cylindrical and bigger in diameter than raw fiber. The tenacity (g/tex) of all dyed yarns decreased and elongation (%) were increased compared with the raw yarn due to breakdown of inter-molecular forces during the pre- treatment and dyeing processes. The density (g/cm<sup>3</sup>) of the dyed yarns was found decreased but in case of wicking height (cm) and moisture content (%) it was increased in comparison with raw yarn. Dyeing of eri matka silk yarn with mango (*Mangifera indica*) bark dye in presence of natural mordants i.e., tea leaves (*Camellia sinensis*) and myrobalan (*Terminelia chebula*) obtained good colourfastness properties to sunlight, increased depth of the colour and colour strength (K/S) compared with the metallic mordanted (alum) dyed yarn. Hence, it could be concluded from the study that natural mordant with natural dye obtained excellent effect on eri matka silk yarn.

## **Ecofriendly Utilization of Eucalyptus Bark Extract for Dyeing of Silk with Natural Mordant**

*Pinki Gogoi*

From ancient times till the discovery of synthetic dyes in the 19th century natural dyes have been practiced. Natural dyes have received worldwide attention due to hazardous synthetic dyes. The dye obtained from the natural source used for dyeing in textile materials was safe and biodegradable. So, therefore people are shifting towards eco-friendly products. Considering the growing importance and significance of natural dyes all over the world. The present investigation on “Ecofriendly Utilization of Eucalyptus Bark Extract for Dyeing of Silk with Natural Mordant” was undertaken to evaluate the following objectives: 1. Extraction of natural dye from the bark of eucalyptus. 2. Analysis of colourfastness properties of the dyed mulberry silk yarn. 3. Evaluation of physical properties of the dyed yarn. In the course of the study, mulberry silk yarn was dyed using eucalyptus bark as a natural dye and the banana pseudo stem as a natural mordant. For extraction of eucalyptus bark, an aqueous medium was employed with an optimum wavelength of 580nm which shows the highest optical density is 1.743. Based on the objectives different dyeing conditions were optimized such as extraction medium, extraction time, dye concentration, dyeing time, mordanting time, mordant concentration and mordanting methods. Pre-treatment procedures such as degumming and bleaching were carried out for dyeing in mulberry silk yarn. During the experimental processes, some of the dyeing conditions were kept constant such as material to liquor ratio of 1:30 for dyeing at 70°C. To determine the absorption (%) optical density values of the dye solution before and after dyeing was recorded. Mordant plays an important role in the colour of yarns and colourfastness properties were influenced by the type of mordant used. Eucalyptus dye showed yellowish-brown with mordant on mulberry silk yarn. The colourfastness of all dyed samples was found to be satisfactory. SEM and FTIR were also done for all the samples. As regards physical properties, a decrease in tenacity and increase in elongation may be due to the breakdown of inter-molecular bonds during dyeing. The wicking height and moisture regain of dyed yarn were found to increase after dyeing. Hence from the study, it was found that eucalyptus bark can be used effectively for the dyeing of mulberry silk yarn.

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**Abstract of M.Sc. thesis**

**Department: Textiles and Apparel Designing**

**Major Adviser: Dr. Rickey Rani Baruah**



## **Development of Color Palette Using “*Rubia cordifolia*” Dye for Creating Sustainable Fashion From Eri Silk**

*Rubi Pranjana Tamuli*

The craft of dyeing was crucial in enhancing the textile's beauty. Dyeing is the process of giving thread, cloth, and other materials specific colours and tints by using colouring agents. People all over the world are becoming more interested in natural dyes as a result of the environmental damage and pollution caused by synthetic dyes. It has drawn notice from all over the world that natural dyes are making a comeback as a safer alternative to synthetic colours. Since they are non-toxic, biodegradable, and safe, the search for eco-friendly dyes is essentially global. Mostly dull or subtle colour is produced by it. Though just a few natural dyes are extraordinary, bright colours are typically not found in them. In order to create eco-friendly clothing, natural dyeing is currently a key area of fashion design. Aware of how significant natural dyes are over the world, the present investigation entitled “Development of Color Palette using “*Rubia Cordifolia*” Dye for Creating Sustainable Fashion from Eri Silk” was undertaken to assess the following objectives: Optimization and application of Manjistha dye on Eri silk fabric. • Analysis of color fastness properties of the dyed fabric. • Source of natural dye Manjistha (*Rubia Cordifolia*) was selected to carry out the study to develop variety of harmonizing natural shades on Eri silk fabric using alum and myrobalan mordant. Different dyeing conditions such as extraction medium, extraction time, dye material concentration, mordanting time, mordanting methods such as pre, simultaneous and post were optimized for Manjistha dye based on absorption of dye by the Eri silk fabric. Different shades of colour like brick red, orange and brown were obtained by with optimum dyeing conditions. A series of experiments were carried out to optimize the different dyeing conditions such as colourfastness properties for the selected dye. The fastness properties of washing, crocking or rubbing (dry and wet), pressing (dry and wet), sunlight, perspiration (acidic and alkaline) of all the dyes samples were found to be satisfactory i.e. rated fair to good. As regards physical properties of the dyed samples the tenacity and elongation of dyed fabrics were decreased due to breakdown of

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**Abstract of M.Sc. thesis**

**Department: Textiles and Apparel Designing**

**Major Adviser: Dr. Rickey Rani Boruah**

intermolecular forces during dyeing and other processes. The increased and decreased in fabric count might be due to the consolidation of yarn during dyeing and swelling and absorption of dye. On the other hand the wicking behaviour, thickness and moisture regain of dyed fabrics were found to increase after dyeing. The stiffness of the dyed fabric samples showed decreasing trend of bending length might be due to degumming, bleaching and dyeing of fabric. Thus, from the study, it can be stated that different mordant on natural dyes produce distinct hues or palettes of colour and are eco-friendly enough to be utilised efficiently for dyeing Eri silk fabric, which in turn provides the fabric a new look and aids in product diversification.

## **Development of Mulberry Silk Union Textiles for Sustainable Fashion**

*Shradhasmita Dutta*

The present investigation was undertaken to study the “Development of Mulberry Silk Union Textiles for Sustainable Fashion”. The study was carried out in Jorhat district of Assam. Mulberry, Cotton and Polyester yarns were selected and union fabrics with plain and twill weaves were developed. Mulberry silk yarn was used as warp and Cotton and Polyester were used as a weft. Fabrics of Mulberry x Mulberry, Mulberry x Cotton, Mulberry x Polyester were developed using both plain and twill weave. The constructed fabrics were analysed by the assessment of mechanical, physical and comfort properties. Product were prepared using the constructed union fabrics and opinion of respondents were taken regarding the appearance and tactile properties of the fabrics and the suitability of the fabric for the products. Finding of the study revealed that the union fabric showed satisfactory result by keeping them at par with Mulberry x Mulberry fabrics. As per opinion of the respondent, Mulberry x Cotton twill obtained 1st rank Mulberry x Polyester plain obtained 2nd rank and Mulberry x Cotton plain obtained 3rd rank, Mulberry x Polyester twill obtained 4th rank and Mulberry x Mulberry twill obtained 5th rank and Mulberry x Mulberry plain obtained 6th rank.

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## **Optimization of Extraction and Dyeing Parameters of Lac dye from *Kerria chinensis* (Mahd.) on cotton**

*Sourav Baruah*

The present investigation entitled "Optimization of extraction and dyeing parameters of Lac dye from *Kerria chinensis*(Mahd.) on cotton" was conducted during the year 2019-21. In this study dyeing of cotton was done using Lac dye from species *K. Chinensis* with the following objectives. 1. Standardization (optimization) of extraction and dyeing parameters of Lac dye. 2. Evaluation of the colour fastness properties of dyed cotton yarn. Natural dyes are emerging globally as eco-friendly colourant. The greater part of natural dye is vegetable dye obtained from plant source but there are dyes also obtained from insects e.g., Lac Dye. Lac is an animal originated insect dye which is found in India. They can also produce variety shades of colour. During the investigation, HCl, water and Na<sub>2</sub>CO<sub>3</sub> were used for acidic, aqueous and alkaline extraction method respectively. Result showed that the optimum extraction was 10% for each medium at 60°C for 60 minutes, 90°C for 100 minutes and 40°C for 75 minutes in acidic, aqueous and alkaline medium respectively. The natural colourant extracted from Lac insect (*Kerria chinensis*), was utilized for colouration of cotton yarn and their dyeing properties were investigated. Four different mordants such as alum, myrobalan, aluminium sulphate and ferrous sulphate were used on cotton yarns at different concentrations with pre, simultaneous and post-mordanting method to assess the colour fastness properties of the dyed samples. Results showed that, mordant has a significant effect on the colour of yarns and fastness properties were influenced by the type of mordants used. Lac dye showed burgundy to purple colour with mordant alum and orange to red orange colour with mordant aluminium sulphate, faded red in mordant myrobalan and ferrous sulphate shows dark grey colour on cotton yarn in different medium. Alum mordant showed more excellence in physical properties of dyed yarn while aluminium sulphate shows more excellence in colour fastness. Dyed cotton yarn exhibited the best colour fastness range from very fair to good with aluminium sulphate

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mordant. The cotton yarn samples dyed with alum was found to be better than myrobalan, aluminium sulphate, and ferrous sulphate in respect of tenacity (g/tex), wicking height (cm) and moisture regain (%). Cotton yarn samples mordanted with myrobalan showed highest density, wicking height and moisture regain. The myrobalan mordanted dyed cotton yarn showed highest tenacity and elongation.

## **Extraction of fibre from *Ricinus communis* and evaluation of its physical and chemical properties**

*Trideep Bor Saikia*

The present study was carried out to investigate the possibility of utilizing castor plant fibre for developing diversified environmental friendly products. Castor plant stems, which remain after harvesting the leaves and seeds, are considered as an agricultural waste but never used as a source of natural fibres. Efforts have been made in the present investigation to extract fibres from the sheaths peeled from the castor stems and subjecting it to wet processing treatments like scouring and bleaching for making diversified products. Castor fibres were extracted by alkali extraction method and the extracted fibres were subjected to wet processing treatments, i.e. scouring and bleaching. Various morphological, physical, chemical properties as well as solubility percentage of raw along with scoured and bleached castor fibres in different solvents were evaluated. Morphological properties of the fibre were found to be highest in raw castor fibres as compared to scoured and bleached fibres. Physical properties except elongation were found to be highest in raw castor fibres. Elongations of the scoured and bleached fibres were found to be more than the raw fibres. Chemical constituents except moisture content were found maximum in raw castor fibres, followed by scoured and bleached castor fibres. The moisture content was found maximum in scoured and bleached fibres. Solubility of scoured and bleached fibres were more in all the solvents as compared to raw fibres. Maximum mechanical properties of fibres were also observed in raw fibre and minimum were found in scoured and bleached fibre. The Infra-Red spectrum and Scanning Electron Microscope (SEM) test depicted the removal of non cellulosic material from the surface of the fibres after wet processing treatment. From the extracted fibre five different products were developed namely coin purse, tea coaster, mobile purse, disposable plate and fibre reinforced composite board. All the developed items were found to be suitable based on their quality and their intended use.

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## **Master of Science (Veterinary)**

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- **Animal Biotechnology**
- **Animal Genetics and Breeding**
  - **Animal Nutrition**
- **Animal Reproduction, Gynaecology and Obstetrics**
  - **Anatomy and Histology**
    - **Biochemistry**
- **Clinical Medicine, Ethics and Jurisprudence**
  - **Epidemiology and Preventive Medicine**
    - **Extension Education**
      - **Microbiology**
      - **Parasitology**
      - **Pathology**
- **Pharmacology & Toxicology & Jurisprudence**
  - **Physiology**
  - **Public Health**
  - **Surgery and Radiology**
- **Livestock Production and Management**
  - **Livestock Products Technology**
    - **Poultry Science**

## **Evaluation of PagN-Based Peptide(S) in Combination with Vi-Capsular Antigen as Vaccine Candidate for *Salmonella* Typhi**

*Puranpurna Goswami*

The present study was undertaken with a view to select the peptides representing the most potent B-cell and T-cell epitopes in the extracellular loops of PagN protein, synthesize them and evaluate their immunogenicity and protective efficacy either alone or in combination with Vi-polysaccharide in a mouse model against *Salmonella* Typhi. For this, the most potent B-cell and T-cell epitopes were selected using Ellipro and DiscoTope tools of IEDB resources and were chemically synthesized.

For immunogenicity study, the synthetic peptides of PagN protein in combination with Vi-polysaccharide were injected intraperitoneally in three different combinations, viz., 10µg of Vi-polysaccharide, 10µg of Vi-polysaccharide +100µg of each peptides, and 100µg each of all the peptides, into each of the six mice of Groups 2, 3 and 4, respectively, while the mice in Group 1 were kept as the control. Indirect ELISA was carried out to monitor the immune response against the peptides and Vi-polysaccharide.

The antibody titre against the synthetic peptides and Vi-polysaccharides showed a significant rise in all the three immunized groups (Groups 2, 3 and 4) as compared to the control group from day 7 till day 42. A significant rise in antibody titre was observed in both the Groups 3 and 4 in respect of the synthetic peptides, which sustained till the end of the study (till 42<sup>nd</sup> day of the experiment). In respect of Vi-polysaccharide, it was observed that there was a significant rise of antibody titre in both the Groups 2 and 3 with higher antibody response in group 3 (peptides +Vi-polysaccharide).

All the mice in different experimental groups were challenged with a lethal dose of *Salmonella* Typhi on the 42<sup>nd</sup> day post-primary immunization and observed for 10 days. All the animals in the control group started showing the symptoms suggestive of salmonellosis and died within 3 days of infection while the group of mice immunized with Peptides + Vi-polysaccharide (Group 3), showed complete protection (100%)

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against *the challenge infection*. The groups vaccinated with the combination of all the peptides(Group 4) and Vi-polysaccharide(Group 2) showed 83.33 percent protection against *S. Typhi*.

The present study showed that the Peptides+Vi-polysaccharide combination may be a very potential vaccine candidate against *S. Typhi*. However, this needs further exploration particularly in respect of its protective efficacy against heterologous challenges, determination of the appropriate time of booster vaccination, and the effect of individual peptides on humoral and cell-mediated immune responses.

# **DNA Polymorphism in Mitochondrial Genes Encoding ND1, CO1 and CYTB in Canine Malignant Tumours**

*Shakeel-Ul-Rehman*

Malignant tumours in dogs are frequently reported. The types of malignancies commonly reported in canines include female breast cancers, lymphomas, adenomas and carcinomas of mast cells. Specific mutations and polymorphism in mitochondrial genes have been shown to be associated with different types of human malignancies. However, similar studies in respect to malignant tumours in dogs are very limited. Hence in the present study, an attempt was made to identify frequency of occurrence of mutation and polymorphism in gene sequences encoding NADH dehydrogenase subunit 1 (ND1), cytochrome b (CYTB) fragments of mtDNA and cytochrome c oxidase subunit 1 (CO1) in dogs, and to define the association of DNA polymorphic mutations with different tumour types.

Based on histopathology, out of 10 tumours examined 5 (50%) were found to be of epithelial and the rest 5 (50%) of mesenchymal origin. Two of the five epithelial tumors were recognized as adenocarcinoma and three as squamous cell carcinoma. Of the five mesenchymal tumors, four were identified as fibrosarcoma and one as liposarcoma. Of the 10 cases, 8 (80%) were recorded in local and 2 (20%) in crossbred dogs. While 7 (70%) cases were recorded in male, 3 (30%) were observed in females. Location-wise, two each of the tumours were observed in skin and mammary gland, while one each was observed in mouth, left flank, abdominal region, testicle, right elbow and left forelimb. The dogs suffering from the neoplastic growth in different parts of the body were within the range of 5 - 13 years of age.

Analysis of three mtDNA gene fragments established a relatively low level of molecular genetic variation between the tissues (tumour tissue, normal tissue and blood) of the individuals examined. Majority of the mutational changes in the *ND1*, *COI* and *CYTB* gene fragments in the analyzed tissues in most of the dogs with tumours were insertions and deletions. Only a few polymorphisms were noted in the partial gene fragments of the analyzed tissues when compared to reference successions.

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Multiple substitutions and insertions have been noted in *NDI* gene fragment; these included four substitutions (C218T, T455C, G498A and C666T) and three insertions (341InsC, 355InsC and 718InsT). However, no mutations were recorded in *NDI* gene fragment from any of the three types of tissues examined in case of a dog affected with squamous cell carcinoma. Changes in *CYTB* gene fragment included two substitutions (C322T and T799C) and one insertion (303InsG) mutation. Polymorphism C322T in the *CYTB* fragment was noted in 40% of the samples analysed. No mutation was, however, detected in this gene fragment in one case of fibrosarcoma. In the *COI* gene fragment, A735G polymorphic mutation was recorded in all (100%) the 10 cases of malignant tumours investigated in the present study. In this gene fragment, instances of mutations recorded were comparatively lesser.

Except for C218T mutation observed in *NDI* gene fragment seven cases of canine malignant tumour that induced S (Serine) to Y (Tyrosine) variation in the amino acid sequence of the coded protein at position 72, no other substitution mutation recorded in this gene fragment could cause a variation at the level of amino acid sequence. On the other hand, none of the mutations detected in *CYTB* gene fragment could induce any change in the level of amino acid sequence of the coded protein. Similarly, the only substitution mutation in the *COI* gene fragment that induced a change at the amino acid level was A813T mutation observed in a case of fibrosarcoma, which caused a G (Glycine) to A (Alanine) variation at 71 position.

Results of the present study showed the effect of two alleles (*NDI*: 218, *COI*: 813) on the amino acid sequence of the coded proteins which suggested consequently their potential role in carcinogenesis. However, the sample size in the present study was too small to infer conclusively about the association of the mutations and polymorphisms identified in the present study with specific malignant tumours in dog.

## **Molecular Characterization of Lactobacilli isolated from Indigenous Ducks of Assam and *in vitro* Assessment of their Probiotic Activity**

*Samiso Kramsapi*

Probiotic being an important bacteria to keep gut healthy are considered as good and helpful bacteria. The present study was mainly undertaken with a view to see if there is presence of good probiotics in Duck gut and if good probiotic candidate could be obtained from different isolates, isolated from faecal samples of cloaca of Duck. Samples were collected from different regions of Assam *viz* Hamren, Barpeta, Beltola, Hojai, Diphu, Karimganj, Kohora, Nagoan, Nalbari, Phuloni, Sivasagar, Sonapur etc from the cloaca of indigenous Ducks of Assam and brought in transport medium i.e Cary Blaire Media. Samples were process and inoculated in MRS broth for isolation of Lactobacillus with overnight incubation, which were further streaked in MRS Media Plate subsequently to obtain pure colonies.

The suspected pure colonies were preliminary identified by studying their Morphology through Gram staining, followed by Biochemical Test like sugar fermentation, Catalase Test which were followed again by PCR. PCR +ve samples were further tested for *In vitro* probiotic activity test for selection of good probiotic candidate. Different *In vitro* probiotic activity test include tolerance to low pH, tolerance to bile, lysozyme tolerance test, Autoaggregation, Cell surface Hydrophobicity, Antimicrobial activity test and Antibiotic sensitivity test.

Out of 320, 122 samples which were PCR +ve were tested for In-Vitro probiotic activity, where 15 samples could surpass low pH tolerance test at pH 2 & pH 2.5, being the main selection test for obtaining good probiotic candidate. The 15 isolates which tolerated low pH test were further tested for other test like Bile, Lysozymes tolerance test and adhesion test like Autoaggregation and Cell surface Hydrophobicity and then followed by Antimicrobial activity test, followed by Antibiotic sensitivity or susceptibility test.

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Altogether 8 samples could surpass all the test, which were further sent for Molecular characterization by outsourcing where 7 were identified as *Lactobacillus Reuteri* & other 1 isolates as *Lactobacillus fermentation. L. Reuteri*, being the common or predominant probiotic Isolates obtained in other Poultry also found to be predominant probiotic isolate in Ducks too while *L. fermentation*, which are mainly found in fermented products could also be recovered from Duck faecal sample collected from cloaca. The 8 probiotic candidate which surpass all the *In vitro* probiotic activity test could be used as a future probiotic candidate only if further study undertaken with inclusion of *In vitro* Test.

## **Performance of Indigenous Chicken in Certain Districts of Assam Under Backyard Farming System**

*Jehirul Islam*

The study was conducted on indigenous chickens of Darrang and Udalguri district of Assam to evaluate growth, performance and reproductive traits. Data on body weights relating to 747 birds were used in the study. The data of 115, 137 and 95 number of birds were utilized for age at first egg, annual egg production and reproductive traits respectively. Fifty eggs were randomly collected for the study of egg quality traits. Data were collected during the period from August, 2020 to June, 2021 through field survey and interviewed the farmers with pre-tested questionnaire. The overall least-squares means of body weight at day old stage, 20 weeks and 40 weeks were found to be  $28.332 \pm 0.218$ ,  $745.719 \pm 4.479$  and  $1296.984 \pm 6.971$  g respectively. The body weight of males at 20 weeks and 40 weeks were found to be  $779.924 \pm 7.995$  g and  $1389.121 \pm 11.670$  g and the corresponding values of females were found to be  $711.513 \pm 5.407$  g and  $1204.846 \pm 8.691$  g respectively. Chicken of Darrang district had higher body weight of  $29.002 \pm 0.304$ ,  $750.310 \pm 6.215$  and  $1302.030 \pm 9.596$  g at day old stage, 20 and 40 weeks of age than Udalguri district with  $27.662 \pm 0.314$ ,  $741.128 \pm 6.461$  and  $1291.938 \pm 10.142$  g respectively. Significant effect of district on body weight at day old stage ( $P < 0.01$ ), 20 weeks ( $P < 0.05$ ) and 40 weeks ( $P < 0.01$ ) were observed. The overall least-squares means for age at first egg was found to be  $199.286 \pm 4.236$  days. The least-squares means for age at first egg in Darrang and Udalguri district were  $196.741 \pm 7.986$  and  $201.831 \pm 9.022$  days respectively which were found to be non-significant. The overall least-squares means for annual egg production was found to be  $65.236 \pm 0.813$  numbers. The least-squares means for annual egg production in Darrang and Udalguri district were  $67.901 \pm 1.137$  and  $65.570 \pm 1.162$  numbers respectively which were found to be significant ( $P < 0.01$ ). The overall mean for egg weight (g), Albumen index, Yolk index, Haugh unit, Shell thickness (mm) and Shape index were recorded as  $40.54 \pm 0.63$ ,  $0.077 \pm 0.003$ ,  $0.502 \pm 0.006$ ,  $70.213 \pm 0.700$ ,  $0.323 \pm 0.003$  and  $75.725 \pm 0.407$

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respectively. The egg shell colours were mostly light brown followed by creamy white. The average fertility and hatchability were recorded as 90.75 % and 87.42 % respectively.

# Effects of Feeding of Prebiotics, Probiotics and Synbiotics in Broiler Chicken on Corn-Soya Based Diet

*Aibaniairi Fancon*

An experiment was conducted at the Experimental Poultry Shed of the Department of Animal Nutrition, College of Veterinary Science, Assam Agricultural University, Khanapara, Assam to assess the effect of dietary supplementation of Prebiotic, Probiotic and Synbiotic on the performance, nutrient utilization, haemato-biochemical parameters and carcass traits of broiler birds. One hundred and eighty (N=180) day old commercial (Ven Cobb) broiler chicks were randomly distributed into four treatments groups. Each treatment had three replicates with 15 chicks in each replicate. Dietary groups consisted of Group-T0(control) birds which were fed basal diet without any supplementation; In Group-T1, birds were fed basal diet supplemented with Prebiotic (@ 0.2%); Group-T2: basal diet with 0.035% Probiotic; Group-T3(Synbiotic) contains basal diet with Prebiotic @0.2% + Probiotic @ 0.035 respectively. The basal diet was prepared as per ICAR (2013) recommended for Pre-starter, Starter and Finisher phase using commonly available feed ingredients. Results of the study showed that the average weekly body weight change (g/ bird), weekly gain in weight and total gain were significantly higher ( $P<0.05$ ) in synbiotic, i.e., T3 group as compared to the other groups. The total gain in weight during the entire experimental trial was  $1669.46\pm 33.46$ ,  $1724.219\pm 33.14$ ,  $1770.173\pm 38.50$  and  $1827.952\pm 40.36$  (g/bird) for T0, T1, T2 and T3 groups respectively. The feed intake did not differ significantly among the groups. However, significantly better ( $P<0.05$ ) FCR was observed in T3, followed by T2, T1 and T0. The Broiler Performance Efficiency Index (BPEI) among the experimental groups was  $91.06\pm 0.05$ ,  $98.67\pm 0.05$ ,  $104.66\pm 0.04$  and  $109.88\pm 0.05$  for T0, T1, T2 and T3 group, respectively; where T3 showed the best ( $P<0.05$ ) BPEI followed by T2, T1 and T0. The retention of Nitrogen differed significantly among the groups, with T3 showing better results as compared to the other groups. However, Retention of Phosphorus and Calcium did not differ significantly among the groups. The serum total protein, albumin, globulin, superoxide dismutase and GGT did not show any significant effect among the

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treatment groups, however serum cholesterol was lowest ( $P<0.05$ ) in T3 group as compared to the other groups. The dressing percentage, prime cuts, giblet weights, lymphoid organs weight did not differ significantly among the groups. Caecal microbial profile showed that Lactic acid bacteria was increased significantly in the prebiotic and probiotic supplemented groups, whereas *E. coli* count did not show any significant effect among the groups. The net profit per bird was found highest in the T3 group (Rs.20.51), followed by T2 (Rs.16.13), T1 (Rs.12.37) and T0 (Rs.6.54) groups.

**Key words:** Broiler, Prebiotic, Probiotic, Synbiotic, Carcass traits, Haemato-biochemical parameter, Feed conversion ratio

# **Effect of Black Pepper (*Piper nigrum*) Supplementation to Diets Containing Different Levels of Energy on the Growth Performance, Nutrient Utilization and Blood Biochemical Profile of Growing Pigs**

*Akash Mahanta*

An experiment was conducted to study effect of black pepper (*Piper nigrum*) supplementation to diets containing different levels of energy on the growth performance, nutrient utilization and blood biochemical profile of growing pigs and to evaluate economics of feeding. Twenty four (24) weaned male castrated crossbred piglets were randomly divided on the basis of body weight into 4 groups i.e. BP0, BP1, BP2, and BP3, comprising 6 piglets in each group. Piglets of all the groups were fed individually. The control group BP0 was fed with a standard grower ration (basal diet) as per ICAR (2013) specification. The pigs in the group BP1 were fed the standard grower ration with supplementation of 0.5% black pepper powder. Pigs belong to group BP2 were fed ration having 3% lower energy with supplementation of 0.5% black pepper powder and the group BP3 fed with the ration having 3% higher energy with supplementation of 0.5% black pepper powder. Blood were collected at 0, 56th and 112th day of the feeding trial and analyzed for blood biochemical parameters. The economics of feeding was calculated.

Significant ( $P < 0.01$ ) differences were observed in fortnightly gain in body weight, average daily gain, overall FCR, digestibility coefficient of dry matter, organic matter and ether extract, blood cholesterol and serum LDL levels. Non significant ( $P > 0.05$ ) difference were observed in total feed intake, digestibility coefficient of crude protein, crude fibre and nitrogen free extract. Economics of production when calculated and revealed that supplementation of black pepper at 0.5% was profitable as compared to feeding ration without supplementation. The highest profit was observed in group BP2. Based on the results obtained in the present study, it could be concluded that growing pigs could be reared more profitably and with better blood biochemical profiles on a ration supplemented with @ 0.5% black pepper.

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**Abstract of M.Sc. thesis**

**Department: Animal Nutrition**

**Major Adviser: Dr. Gunaram Saikia**

## **Effect of Feeding Dry *Moringa oleifera* Leaves on Growth Performance and Nutrient Utilization in Crossbred Calves**

*Anisul Hamza*

An experiment was carried out to evaluate the effect of feeding dry *Moringa oleifera* leaf meal (MOLM) on growth performance, nutrient utilization, biochemical parameters and cost of feeding. Twenty four numbers of crossbred calves of same age group were selected irrespective of sex and distributed randomly into four groups (T<sub>0</sub>, T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub>) of six animals in each group. 84 days feeding trial was carried out. The control group (T<sub>0</sub>) was fed with conventional feed comprising concentrate mixture, green grass (Napier) and paddy straw. The treatment groups were fed with roughage (green and dry roughage) same as control and iso-nitrogenous concentrate mixture with inclusion of 5% MOLM in T<sub>1</sub>, 10% MOLM in T<sub>2</sub> and 15% MOLM in T<sub>3</sub>. At the end of feeding trial 5 days metabolic trial was conducted with 5 animals from each group.

The feed intake was not affected due inclusion of MOLM in calves diet. However, total body weight gain, average fortnightly and daily gain differed significantly among the groups and highest observed in T<sub>3</sub> group followed by T<sub>2</sub>, T<sub>1</sub> and T<sub>0</sub>. Significantly (P<0.05) better FCE was observed with the increasing level of MOLM inclusion i.e. better in T<sub>3</sub> followed by T<sub>2</sub>, T<sub>1</sub> and T<sub>0</sub>. No significant difference (P>0.05) were observed in respect of digestibility coefficient of DM, OM, CF, EE, NFE, NDF and ADF among the groups, however CP digestibility was significantly (p<0.01) higher in T<sub>3</sub> and lowest in T<sub>0</sub>. All animals of different groups were observed positively balanced in case of nitrogen, calcium and phosphorus balance. Significantly higher retention of nitrogen and calcium were observed in T<sub>3</sub> group and lowest in T<sub>0</sub> group. Plan of nutrition revealed that protein and energy received by the treatment groups were adequate as per ICAR 2013 requirement.

Blood biochemical parameters viz. Blood glucose, serum total protein, serum albumin, serum globulin, blood urea nitrogen and gamma glutamyl transpeptidase were within the normal range and did not affected by MOLM feeding in calves. But, blood SOD were significantly (P<0.01) higher in groups fed with MOLM included concentrate

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feed. The relative feed cost per Kg weight gain was lowest in T<sub>3</sub> followed by T<sub>2</sub>, T<sub>1</sub> and T<sub>0</sub>.

The present study revealed that the dried *Moringa oleifera* can be included in the concentrate mixture of calves upto 15% without any adverse effect to improve their performance and to reduce the cost of feeding.

## **Performance of Broiler Chicken Fed on Diet Supplemented with Oregano Essential Oil**

*Biswajit Borah*

An experiment was conducted to study the performance of broiler chickens fed on a diet supplemented with Oregano Essential Oil. For the study, One Hundred eighty (n=180) Day old Broiler chicks of Ven Cobb 430Y strain were randomly divided into four groups (T0, T1, T2 and T3) having 45 chicks per group on the basis of their body weight, the groups were again subdivided into 3 replicates of 15 birds each. The control group was fed with basal diet or the standard pre-starter, starter and finisher diet which were formulated to meet the nutrient requirements as per ICAR, 2013 with the locally available ingredients. And the other three groups were fed with the same basal diet like the CONTROL group but with an additional supplementation of Oregano Essential Oil in the following concentrations: T1 (OEO@200mg/kg basal diet), T2 (OEO@400mg/kg basal diet) and T3 (OEO@600mg/kg basal diet).

The experimental results showed significantly ( $p<0.05$ ) higher change in the body weight, total gain in the body weight, total feed intake and overall feed conversion efficiency in the groups T2 and T1 than the groups T3 and T0. The Broiler Performance Efficiency Index (BPEI) was also higher in the group T2 followed by T1, T3 and T0 respectively. Digestibility of Dry Matter (DM) and retention of nutrients like Nitrogen were found to be significantly ( $p<0.05$ ) better in the treatment group than the control group. The Dressing percentage (%PSW) was also significantly improved in the treatment groups; T2 was having the highest dressing % followed by T1, T3 and T0. The weight of the Cut Parts (%PSW) was better in the treatment group; however, there was no significant difference. The giblet weight (%PSW) was also not significantly different among the groups. There was no significant ( $p>0.05$ ) in terms of Total protein, HDL-C, and LDL-C. The blood lipid profile was also not significantly ( $p>0.05$ ) different among the different treatment groups. And also there was no significant ( $p>0.05$ ) difference was observed in terms of caecal microbial load. The study revealed that supplementation of Oregano Essential Oil at a concentration of 200mg/kg basal diet improved the net profit of the broiler production. On the basis of all these experimental findings supplementation of OEO @400mg/kg basal diet was found to be better on the growth performance of the broiler chicken.

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**Department: Animal Nutrition**

**Major Adviser: Dr. Anurup Kumar Gohain**

## **Effect of Feeding Nano-Iron on Growth Performance and Nutrient Utilization in Grower Pigs**

*Dangshawa Morung*

An experiment was conducted to investigate the effect of feeding nano-Fe on growth performance and nutrient utilization in grower pigs. Twenty four (N=24) weaned pigs of HDK-75 having average body weight  $21.50 \pm 0.38$  kg of above two months of age irrespective of sex were selected from AICRP pig farm, College of Veterinary Science, Khanapara, Guwahati-22. Selected pigs were randomly allotted in four treatment groups, each group with 6 pigs on body weight basis. The treatment groups were T0 (Control), T1 (100 mg inorganic iron as  $\text{FeSO}_4$ ), T2 (75 mg organic iron as methio-chelated) and T3 (50 mg nano iron as  $\text{FePO}_4$ ). The basal diet was prepared according to NRC (2012) recommendation for grower pigs. The feeding trial was conducted for 90 days. Result of the study showed that in average fortnightly body weight change, significant difference ( $P < 0.05$ ) was observed from 75th to 90th day. At the end of the feeding trial, the average body weight of different treatment groups was  $50.67 \pm 0.35$ ,  $51.22 \pm 0.44$ ,  $51.76 \pm 0.43$  and  $54.25 \pm 0.47$  kg for T0, T1, T2 and T3 groups, respectively. In body weight gain, significant difference ( $P < 0.05$ ) was observed from 60th to 90th day where the total gain in weight were  $29.17 \pm 0.004$ ,  $29.72 \pm 0.003$ ,  $30.26 \pm 0.001$  and  $32.75 \pm 0.004$  kg in T0, T1, T2 and T3 groups, respectively. The feed intake was not differed significantly ( $P > 0.05$ ) among the different treatment groups. However, FCR showed significant difference ( $P < 0.05$ ) from 60th to 90th day among the different treatment groups. The average FCR of different experimental groups was  $3.72 \pm 0.16$ ,  $3.67 \pm 0.10$ ,  $3.56 \pm 0.19$  and  $3.30 \pm 0.12$  T0, T1, T2 and T3 groups, respectively. The digestibility of nutrient was not showing any significant affect except NFE digestibility which was significantly ( $P < 0.05$ ) higher in T3 group. In hematological profiles, Hb, PCV and RBC values were significantly ( $P < 0.05$ ) higher in T3 group as compared to other treatment groups and there was no significant difference ( $P > 0.05$ ) observed for platelet, WBC, lymphocyte, monocyte and granulocyte count. In blood biochemical parameters, serum protein and serum iron was found significantly ( $P < 0.05$ )

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higher in T3 group and there was no significant difference ( $P>0.05$ ) observed for blood glucose, albumin, globulin, A: G, AST, ALT and BUN but all the values were found within normal physiological range in the present study, thus supplementation of nano-Fe @ 50mg per kg of diet improves overall growth performance of experimental pig (HDK- 75) without adverse effect.

## **Effect of Feeding Azolla (*Azolla pinnata*) Based Complete Feed Block on Growth, Nutrients Utilization and Blood Biochemical Parameters of Beetal X Assam Hill Goats**

*Mostafizur Ahmed*

Twenty four growing kids (Beetal x Assam Hill Goat) of 3-4 months of age having mean body weight  $8.12 \pm 0.01$  kg were randomly distributed into four groups of six animal in each group as T<sub>0</sub>, T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> by using randomized block design (RBD). The feeding trial was conducted for 84 days. The control group (T<sub>0</sub>) fed with Complete Feed Block consisting Napier grass and concentrate mixture in the ratio 60:40 to meet the nutrients requirement as per feeding standards of ICAR (2013). In the treatment groups T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub>, the concentrate mixture was replaced with dried Azolla (*Azolla pinnata*) at levels of 10%, 20% and 30%, respectively. The concentrate mixture of experimental groups T<sub>0</sub>, T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> had 13.01, 13.01, 13.02 and 13.01 percent DCP and 69.98, 69.47, 68.20 and 68.10 percent TDN respectively. At the end of the feeding trial, 5 kids from each group were randomly selected for digestion trial for a period of 3 days after 2 days of adaptation.

The total feed intake and average daily feed intake differed significantly ( $p < 0.01$ ) among the groups and T<sub>1</sub> had significantly ( $p < 0.01$ ) higher intake followed by T<sub>0</sub>, T<sub>2</sub> and T<sub>3</sub>. The total gain and average daily gain in body weight differed significantly ( $p < 0.01$ ) among the groups. Significantly ( $p < 0.01$ ) higher body weight gain was observed in T<sub>1</sub> followed by T<sub>0</sub>, T<sub>2</sub> and T<sub>3</sub>. The feed conversion efficiency (FCE) of T<sub>0</sub>, T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> groups were  $8.83 \pm 0.16$ ,  $8.38 \pm 0.17$ ,  $9.23 \pm 0.14$  and  $9.57 \pm 0.15$  respectively and significantly ( $p < 0.01$ ) better FCE was observed in group T<sub>1</sub>. Digestibility coefficient of DM, OM, CP and NFE differed significantly ( $p < 0.01$ ) among the groups and significantly higher ( $p < 0.01$ ) digestibility coefficient of DM and CP were observed in group T<sub>1</sub> and lowest in T<sub>3</sub>. Plane of nutrition revealed that the protein and energy received by different treatment groups of kids fulfilled the nutrient requirement as per ICAR (2013).

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The blood biochemical parameters viz. total serum protein, total serum albumin and GGT were within normal range. The average OD value of ELISA showed Azolla has no effect on the immune response. No significant difference ( $p>0.05$ ) was observed among experimental groups in total serum protein, total serum albumin, GGT and humoral immune response.

The cost of feeding per kg live weight gain was lowest in T<sub>1</sub> (126.31±2) in comparison to T<sub>0</sub> (135.52±2), T<sub>2</sub> (136.47±1.94), and T<sub>3</sub> (138.67±2.20). From the present study, it has been revealed that, dried Azolla can be incorporated at 10% level in concentrate mixture of Complete Feed Block of Beetal x Assam Hill Goat kids with a distinct economic advantage without any adverse effect.

## **Effect of Supplementation of Acidifier on the Performance of Broiler Chicken**

*Rupjyoti Dutta*

One hundred twenty day old broiler chick of uniform body weight were divided into 4 different groups of 15 chick each *viz.* T0, T1, T2 and T3. Birds in all group were offered broiler starter (CP 21.5% and 3056 ME Kcal) and broiler finisher (CP 19.5% and 3100 ME/kg diet) from 0-21 days and from 22-42 days of age respectively. No acidifier was added in the diet of T1 group i.e. control group. The other three groups were fed acidifier in the diet @ 0.1%

At the end of 6<sup>th</sup> week, the average body weight was 2168.37, 2209.17, 2107.53 and 1883.57 and the average total body weight gain was 1906.20, 2154.90, 2029.20 and 1821.30 for T0, T1, T2 and T3 group respectively. The average daily gain was 49.86, 51.31, 48.31 and 43.36 for T0, T1, T2 and T3 groups respectively. The average total feed intake was 3447.82, 3544.42, 3627.23 and 3560.33 and the average feed conversion was 1.73, 1.65, 1.78 and 1.97 for T0, T1, T2 and T3 group. The average weekly protein efficiency rate was 2.99, 3.15, 2.94 and 2.62 for T0, T1, T2 and T3 group. The percentage of retention of nitrogen was 69.21, 70.46, 69.08 and 69.19 calcium was 62.72, 62.57, 61.46, 60.46 and phosphorous was 48.01, 49.19, 49.19 and 50.01 for T0, T1, T2 and T3 group. The average dressing percentage was 73.71, 74.19, 73.40 and 68.45 and total giblet weight percentage were 3.12, 3.06, 3.16 and 3.17 for T0, T1, T2 and T3 group respectively.

Meat compositions showed that moisture percentage was 73.62, 73.35, 74.32 and 74.80 for T0, T1, T2 and T3 group respectively.

The protein and fat percentage in meat was 18.84, 19.26, 18.82, 17.08 and 6.34, 6.62, 6.28 and 6.04 and 0.75, 0.80, 0.79, 0.74 for ash.

Overall mean concentrations of serum protein, blood glucose level, serum calcium and serum inorganic phosphorous was 3.84, 3.87, 3.78, 3.75, 188.62, 187.46, 184.14, 184.78, 5.22, 6.88, 6.62, 6.58 and 5.43, 5.55, 5.50, 5.63 respectively.

The cost of feeding per kg body weight gain was Rs. 62.16, 58.16, 60.92, 70.21. The cost of feed was cheaper in T1 and T2 as compared to T0 and T3 group.

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On the basis of the above results of the present study it can be concluded that supplementation of acidifier in broiler diet with normal protein and energy diet as per (ICAR 2013) is advantageous for broiler production.

## **Effect of Feeding Varying Levels of Subabul (*Leucaena leucocephala*) Leaf Meal on The Performance of Broiler Chicken**

*Tanmoy Medhi*

An experiment was conducted to study the effect of feeding varying levels of subabul (*Leucaena leucocephala*) leaf meal on on growth, nutrient utilization, blood biochemical profile, carcass characteristics and to evaluate economics of feeding in commercial broiler chicken. One hundred eighty (N=180) commercial broiler chicks (Vencobb 400) were randomly distributed into 4 groups (T0, T1, T2 and T3) on live weight basis comprising of 45 chicks in each group with three replicates of 15 chicks in each. The control group (T0) was fed with a standard pre starter, starter and finisher broiler ration as per ICAR (2013) specifications. The chicks belonging to group T1 was fed with standard ration along with 5% inclusion of subabul leaf meal. Birds belonging to group T2 and T3 were fed rations along with inclusion of 10% and 15% subabul leaf meal, respectively in all pre-starter, starter and finisher phases. At the end of pre-starter, starter and finisher phases blood samples were collected and analysed for blood biochemical parameters. Three birds from each group were slaughtered to study the carcass characteristics and chemical composition of meat. The economics of feeding and broiler production were evaluated.

Highly significant ( $p < 0.001$ ) differences were observed in weekly change in body weight, weekly and total gain in body weight, weekly and total feed intake, feed conversion ratio, digestibility of nutrients, retention of nitrogen. Dietary inclusion of subabul leaf meal at 5% level had no adverse effect on growth performance, digestibility of nutrients and carcass characteristics. Non-significant ( $p > 0.05$ ) differences were observed in retention of calcium and phosphorus, dressing percentage, yield of prime cuts, serum total protein, total cholesterol and total triglyceride level. Cost of production when calculated revealed that inclusion of subabul leaf meal at 5% level in broiler rations was more profitable than feeding diets without any inclusion or beyond 5% level of inclusion i.e. 10% and 15%. The highest gross profit was observed in treatment group T1, receiving 5% inclusion of subabul leaf meal. Hence, the study indicated that broilers could be reared more economically and profitably on broiler rations with 5% level of subabul leaf meal inclusion.

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## **Effect of Bypass Fat and Bypass Protein Supplementation During Transition Period on Reproductive Performance of Assam Hill Goat**

*Akshay Krishnamurti Hegde*

The present study was undertaken to evaluate the response of Assam Hill Goat (AHG) in terms of their productive and reproductive performances upon bypass fat (10g/d/animal) and bypass protein (5g/d/animal) supplementation during the transition period. Twenty-four AHG in transition period (21day prepartum to 21day post-partum) were divided into two equal groups (n=12) viz. T-0 and T-1; where Group T-1 was supplemented with 10 g of bypass fat and 5 g of bypass protein along with their normal diet for a period of 42 days. Group T-0 acted as control and was provided with a normal diet without any supplementation. Blood samples were collected on day -21, -14, -7, 0 (day of kidding), +7, +14 and +21 of the transition period for haemato-biochemical studies. Birth weight (kg), milk yield (ml) and time taken for expulsion of foetus and foetal membrane and incidences of peri-partum diseases were recorded. The results indicated that the supplementation had no significant effect on haematological parameters (TLC, Neutrophil count and Hb), serum Ca, P, glucose, globulin and GGT activity. Serum NEFA levels were significantly ( $p<0.05$ ) lower in supplemented groups on the day of kidding ( $0.75\pm 0.09$  mmol/L) and day 21 of postpartum ( $0.38\pm 0.04$  mmol/L). Significantly ( $p<0.05$ ) higher mean values of total protein on day -14, -7, 0, 7, 14 and 21 ( $6.96\pm 0.21$ ,  $6.99\pm 0.25$ ,  $7.02\pm 0.26$ ,  $7.24\pm 0.28$ ,  $7.03\pm 0.12$  and  $6.95\pm 0.15$  g/dL) and serum albumin values on day -14, 7 and 21 ( $4.46\pm 0.23$ ,  $4.69\pm 0.23$  and  $4.44\pm 0.27$  g/dL) were recorded in T-1 group. Significantly ( $p<0.05$ ) lower mean values of BUN were recorded in T-1 group on day 0, 7 and 21 ( $30.25\pm 1.74$ ,  $35.62\pm 1.58$  and  $42.08\pm 1.45$  mg/dL). The supplemented (T-1) group recorded significantly higher milk yield ( $303.5\pm 21.16$ ,  $306.25\pm 19.67$  and  $310.75\pm 23.93$  ml) on day 14, 21 and 28 respectively after kidding and there was a significant ( $p<0.05$ ) reduction in time taken for the expulsion of foetus ( $89.75\pm 11.84$  mins) and foetal membranes ( $90.50\pm 5.86$  mins). In conclusion the supplementation of bypass fat (10g/day) and bypass protein (5 g/day) during the transition period reduced the effect of negative energy balance, facilitated

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quicker recovery from NEB along with improvement in milk yield and reduced time taken for the expulsion of foetus and foetal membrane.

## **Reproductive Performance in Prepubertal Assam Hill Goat Supplemented with Bypass Fat**

*Arjyarittik Kalita*

Early attainment of puberty and ultimately sexual maturity is very important in the reproductive life of an individual because it increases the productiveness of a herd. Nutrition plays a very important role in enhancing the reproductive performance in animals. The neuronal apparatus which is designed to detect the metabolic rate and energy balance which helps in transmission of circulating concentration of different hormone that in turn signals the nutritional status of the animal to the hypothalamo-pituitary-gonadal axis which affects sexual development. Bypass fat formulation prevents degradation by hydrolysis in the rumen and it can pass to the intestine and get absorbed resulting in more energy to the animals. Fat supplementation in ruminant diet is generally associated with increased cholesterol level, which is a precursor of steroid hormones and hence can improve the reproductive performance. A study was conducted with the primary objectives of evaluating the effect of bypass fat (Hilak, Ayurvet Limited, Delhi) supplementation on reproductive performance and to correlate it with the associated blood biochemical and hormonal profiles of pre-pubertal Assam Hill Goat. A total of 24 numbers of 3 months old pre-pubertal doelings maintained at Goat Research Station, Assam Agricultural University, Burnihat were randomly selected into one control and three treatment groups comprising of 6 animals in each group. Control group was fed with standard basal diet without bypass fat supplementation, treatment 1 group with 10g bypass fat per animal, treatment 2 group with 15g bypass fat per animal and treatment 3 group with 20g bypass fat per animal in addition to the standard basal diet for a period of two months. Blood was collected from each doeling before treatment i.e. day 0, day 30, day 60 and on the day of estrus. Findings of the present study indicated that supplementation of different doses of bypass fat significantly ( $P < 0.05$ ) varied with the period of appearance of first estrus and duration of estrus among the groups. The frequency of occurrence of intermediate estrus was found to be higher (41.66%) in all the groups followed by intense (37.50%) and weak estrus (20.80%). The most common behavioural signs of estrus observed in all the groups were bleating (100.00%), tail wagging (83.33 to 100.00%) and standing to be mounted by male (50.00

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to 100.00%). The most common physical signs of estrus observed in all the groups were scanty and clear vaginal discharge (50.00 to 100.00%) and hyperemia of vulvar mucous membrane (50.00 to 100.00%). There was no significant difference in the mean percent of different cell types in between the groups observed during the cytological examination of the vaginal epithelial cells. Arborization pattern was found to be mostly typical in T-2 and T-3 groups whereas atypical and no fern pattern was observed mostly in the T-0 and T-1 groups. The conception rate was recorded to be higher in groups T-2 and T-3 (83.33%) than in groups T-0 and T-1 (66.66%). Among the blood biochemical parameters, serum calcium, zinc and copper level varied significantly ( $P < 0.05$ ) between and within the groups without affecting the serum phosphorous level. Superoxide dismutase activity was higher ( $P < 0.05$ ) in 15g and 20g bypass fat supplemented groups as compared to the group fed with 10g bypass fat and control. Serum cholesterol level did not vary significantly between the groups whereas it varied significantly ( $P < 0.05$ ) on different days of observation for all the groups. Serum estrogen level varied significantly ( $P < 0.05$ ) between and within groups with higher values in group T-2 and T-3 groups. Serum progesterone level did not differ significantly in between the groups but significant difference was observed in T-2 group on different days of observation. The Body Condition Score was recorded to be significantly higher in T-2 and T-3 groups. Hence, supplementation of bypass fat to the basal diet of pre-pubertal Assam Hill Goat significantly improved the reproductive performance by shortening age at puberty, increasing the duration and intensity of first estrus and thereby improving the conception rate and Body Condition Score. A significant correlation was observed between reproductive parameters like age at puberty and duration of first estrus with blood biochemical parameters like serum cholesterol, SOD, serum calcium, serum estrogen and progesterone.



## **Extrapolation of Gestational Curve and Whelping Time in Bitch**

*Chayanika Das*

To study extrapolation of gestational curve and determination of whelping time, gestation period of six (6) crossbred bitches were divided into first, second and third phases; planned to study on 0-day (day of mating), 10th, 20th, 30th, 40th, 50th day and on the day of term or whelping. Different parameters of physical and behavioural signs, extrafoetal and foetal structures, vaginal cytology and haematobiochemical parameters were taken for the study. The per cent mean of enlarged belly (50.00%) and enlarged udder and teats (83.33%) were first found to be recorded from second phase, while, oozing of milk (100.00%) and vulvar swelling (100.00%) were recorded on third phase of gestation, respectively. The occurrence of reduced appetite, decreased activity, restlessness and nesting behaviour of behavioural signs were found 100.00% on day of whelping. Gestational Sac Diameter (GSD) was first recorded ( $02.17 \pm 0.07$  mm) on 20th day of first phase of gestation. Inner Chorionic Cavity (ICC), Crown Rump Length (CRL) and Foetal Head Diameter (FHD) was first recorded as  $15.03 \pm 0.27$  mm,  $12.98 \pm 0.29$  mm and  $07.05 \pm 0.09$  mm, respectively on 30th day of second phase of gestation in crossbred bitch. The FHD was increasing throughout phases of gestation and found  $29.28 \pm 1.11$  mm diameter on day of whelping. There was highly significant ( $P < 0.01$ ) difference between groups, between day of gestation and between interaction groups x days of gestation. The Foetal Heart Rate (FHR) was first recorded on 30th day of second phase of gestation which was found  $207.17 \pm 4.93$  beats/min. FHR was significantly ( $P < 0.01$ ) differed between days; recorded  $146.00 \pm 7.52$  beats/min on day of whelping. On day of mating (0-day), the Large Intermediate and Superficial Keratinized cells were recorded as  $9.00 \pm 0.52\%$  and  $91.00 \pm 0.52\%$ , respectively. On day of whelping, highest ( $59.67 \pm 0.56\%$ ) and lowest ( $2.67 \pm 1.43\%$ ) values were recorded in case of Small Intermediate cells and Superficial Keratinized cells. There was significant difference ( $P < 0.01$ ) between types of cells on different days of first, second and third phase of gestation. While between days of gestation no significant difference was found. Highly significant ( $P < 0.01$ ) difference recorded in interaction between days of gestation x types of cells. Level of progesterone was increasing from 10th day of gestation ( $29.97 \pm 0.54$

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ng/ml) which dropped on day of whelping to  $1.66 \pm 0.25$  ng/ml. Relaxin level reduced on 10th day of gestation ( $0.39 \pm 0.03$  ng/ml) which then gradually was increasing till 50th day of gestation ( $5.54 \pm 0.39$  ng/ml); on day of whelping recorded as  $3.71 \pm 0.86$  ng/ml. Both progesterone and relaxin were significantly ( $P < 0.01$ ) differed between day of gestation in crossbred bitches. There was highly significant ( $P < 0.01$ ) difference of C-Reactive Protein between day of gestation. On day of whelping C-Reactive Protein was recorded as  $11.62 \pm 2.32$  mg/L. There was significant ( $P < 0.01$ ) difference between calcium and phosphorus; significantly ( $P < 0.05$ ) differed on each day of first, second and third phase of gestation. But, non-significant difference recorded between days of gestation and in interaction between minerals  $\times$  days of gestation. On day of whelping, level of calcium and phosphorus was recorded as  $10.21 \pm 0.31$  mg/L and  $4.47 \pm 0.31$  mg/L, respectively. Haemoglobin and glucose per cent was recorded on day of whelping as  $11.07 \pm 0.54$  gm/dl and  $108.18 \pm 2.90$  mg/dl, respectively. The values were differed non-significantly between days of gestation. From this study it was concluded that pregnancy could be first confirmed based on GSD and FHR, respectively by 20th and 30th day of first and second phase of gestation. On day of whelping, examination of vaginal cytology revealed significantly ( $P < 0.05$ ) increased Small Intermediate cells (SIC), while, Superficial Keratinized Cells (SKC) significantly ( $P < 0.05$ ) decreased. Level of progesterone and relaxin hormone significantly ( $P < 0.05$ ) decreased on the day of whelping.

## **Effect of Nano Zinc Supplementation on Reproductive Performance of Assam Hill Goat**

*Dipika Deori Abstract*

Zinc is considered to be an essential element required for reproduction. Nanotechnology to produce nano size zinc with their novel properties as large surface area, higher bioavailability, better absorption has been an effective alteration for both organic and inorganic zinc sources. A study was conducted with a primary objectives of evaluating the efficiency of nano zinc (NZn) as feed supplementation on reproductive performance and to extrapolate fertility associated blood biochemical and hormonal profiles of Assam Hill Goat. Twenty-four numbers of 7 days post kidding doe maintained at Goat Research Station, Assam Agricultural University, Burnihat were randomly selected into 4 groups comprising 6 animals each where control group of animals were fed with basal diet without zinc supplementation, for treatment 1 group 25mg NZn, for treatment 2 group 35 mg NZn and for treatment 3 group 50 mg NZn/kg concentrate mixture with basal diet were fed for a period of three months. Blood was collected from each does upto 3 months before treatment, every fortnightly and on the day of oestrus. Does were bred naturally at 24 hours from the onset of oestrus and confirmed for pregnancy after two months. Results indicated that supplementation of different doses of nano zinc significantly ( $P < 0.01$ ) varied with the interval between kidding and occurrence of first post-partum oestrus among the groups without affecting the duration of oestrus, intensity of oestrus, behavioural and physical signs of oestrus. Feeding of NZn-35 and NZn-50 mg resulted higher conception rate of 83.33 per cent as compared to NZn-25 and control (66.66%). As regards to birth shape, lying posture was found to be highest (100.00%) followed by standing posture (33.33%) and very few animals (16.66%) were in attempting to stand while giving birth. The duration of stage I, stage II, stage III of parturition and total time taken for parturition were found to be ranging from  $84.17 \pm 12.54$  to  $86.17 \pm 12.48$ ,  $14.00 \pm 1.46$  to  $17.50 \pm 2.62$ ,  $100.00 \pm 10.57$  to  $105.50 \pm 10.83$  and  $198 \pm 12.23$  to  $209.17 \pm 18.16$  minutes respectively among all the group. Placental weight and number of cotyledons were found to be non-significant ( $P > 0.05$ ) among the groups. Supplementation of nano zinc had no effect ( $P > 0.05$ ) on haematological parameter viz. PCV (%), haemoglobin (g/dL), RBC ( $10^6/\mu\text{l}$ ) and WBC

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( $10^3/\mu\text{l}$ ). However, among other biochemical parameter studied, serum zinc level varied significantly ( $P < 0.01$ ) among the groups without affecting the serum calcium, phosphorous and iron level. The serum zinc level was found to be higher in NZn-50 mg as compared to control and NZn-25 and NZn-35 mg. Catalase and superoxide dismutase activity were higher ( $P < 0.01$ ) in 25 mg and 35 mg NZn/kg concentrate mixture supplemented diets as compared to the group fed with 50 mg NZn/kg concentrate mixture and control. Serum progesterone level varied significantly ( $P < 0.01$ ) between treatment and days interaction with higher values in treatment 2 and treatment 3 group at 70<sup>th</sup> and 84<sup>th</sup> day of observation whereas serum estrogen level did not differ significantly ( $P > 0.05$ ) among the group. Hence, zinc supplementation in the form of nano zinc improved the reproductive performance by shortening the interval between kidding and first post partum oestrus and conception rate without much affecting the other reproductive parameter in Assam Hill goats.

## **Diagnostic and Therapeutic Management of Canine Transmissible Venereal Tumour (CTVT)**

*H. Phunchu Bappo*

A total of 30 numbers of dogs affected with Canine Transmissible Venereal Tumour (CTVT) reported to the Gynaecology O.P.D., Veterinary Clinical Complex, Assam Agricultural University, Khanapara, Guwahati-22 during a period of 1 year from October 1<sup>st</sup> 2021 to September 30<sup>th</sup> 2021 were taken for the present study. CTVT was diagnosed based on the history, clinical examination, cytological and histopathological examination. It was observed that the incidence of CTVT was highest (51.02%) in young sexually active dogs of 0-3 years of age of local breeds specially during winter season. The cytological examination revealed the presence of the characteristic cytoplasmic vacuoles with a high nucleus to cytoplasmic ratio. The histopathological examination revealed multiple mitotic figures, cluster of neoplastic cells with distinct nuclei surrounded by fibrous sheath of connective tissues. The dogs were randomly divided into 3 groups based on the treatment protocol *viz.*, Group A, treated with Vincristine sulphate, Group B, treated with a combination of Vincristine Sulphate and Ivermectin and Group C, treated with a combination of Vincristine Sulphate, Ivermectin and Antioxidant injection, with 10 number of animals in each group. The Haemato-biochemical analysis showed leucocytosis, neutrophilia, monocytosis, lymphopenia, anaemia and hypoglycemia and hypoproteinemia with elevated levels of blood urea nitrogen (BUN) and creatinine in the CTVT affected dogs which normalized with the progression of the treatment. There was also a significant increase in the levels of alkaline amino transferase (ALT), aspartate amino transferase (AST) and alkaline phosphatase (ALP) at the end of the study period. The estimation of free radicals and antioxidants revealed an increase in the level of malaondialdehyde and nitric oxide and a reduced level of catalase, glutathione peroxidase and superoxide dismutase in the CTVT affected dogs. The study of the DNA damage biomarker revealed an increased levels of 8-Hydroxy 2'deoxyguanosine in all the dogs affected with CTVT. All the dogs in the group treated with a single drug therapy with Vincristine sulphate required a minimum of 2 doses of chemotherapy for the complete remission of the tumour while 6 out of the 10 dogs in the group treated with a combination of Vincristine sulphate, Ivermectin and

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Antioxidant injection needed a single dose of chemotherapy for complete recovery. Seven of the ten dogs in the group treated with a combination of Vincristine and Ivermectin showed complete remission of the tumour with just a single dose of chemotherapy.

## **Pregnancy Diagnosis in Pig with Special Reference to Biomarker Analysis**

*Jyotimalita Roy*

Early pregnancy diagnosis is an important managerial practice for efficient swine operation. It can identify the non-pregnant or open female and reduce the non productive days by rebreeding or culling them as soon as possible. Therefore, the study was undertaken with the objective of finding the most suitable method for early pregnancy diagnosis in pig with special reference to the biomarker analysis. In the present study, real-time ultrasonography, hormone assays (estrone sulfate and progesterone in various body fluids) using ELISA, and biomarker (micro RNA) analysis using Real Time qPCR were conducted to identify early pregnancy in sows with the goal of selecting the most suitable method among them. A total of twenty healthy and fertile sows belonging to similar age group (2-3 years), maintained at ICAR-All India Coordinated Research Project (AICRP) on Pig, A.A.U., Khanapara and S.S. Agro (Pig Breeding Farm), Rani were selected for this study. The sows were categorized into two equal groups as nonbred (control) and bred animals and pregnancy diagnosis methods were applied. Considering the day of insemination as 0 day, pregnancy diagnostic techniques were carried out on the inseminated sows from 7th day onward at an interval of 3 days till 28th day of gestation. The results were compared with that of the non-bred sows of respective parameters. Pregnancy could be diagnosed in 80 per cent tested pigs on 25th day and rest 20 per cent on 28th day, thus 100 per cent sows were diagnosed to be pregnant by real time ultrasonography. Pregnancy diagnosis using hormone assay was carried out by estimating the level of estrone sulfate and progesterone hormone in various samples collected at different days of gestation. A highly significant difference ( $p<0.01$ ) was observed between the concentration of hormones in non-pregnant and pregnant sows at different days of gestation. Estrone sulfate concentration in serum on day 19 and, saliva and urine on day 16 of gestation were significantly ( $p<0.01$ ) higher in pregnant sows. Moreover, the Progesterone levels in serum and saliva were also increased significantly ( $p<0.01$ ) in pregnant sows on days 16 and 19 of gestation as compared to the findings in non-pregnant sows, respectively. In regards to the

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**Abstract of M.Sc. thesis**

**Department: Animal Reproduction, Gynaecology & Obstetrics**

**Major Adviser: Dr. D. K. Sarma**

biomarker analysis the expression of miRNA could be detected as early as 7th day of gestation considering miR-17 as target gene.

The results obtained from ultrasonography, hormone assay and biomarker expression were analyzed statistically and finally inference was drawn as the biomarker analysis(miRNA) to be the best and earliest method of pregnancy diagnosis in sows among all the tests applied under this present study.



## **Correlation of Insulin Like Growth Factor-1 Concentration with Semen Characteristics of Beetal Buck**

**Keshav**

A total of seventy two ejaculates, six from each of twelve adult Beetal bucks maintained at Goat Research Station, AAU, Burnihat, collected using standard artificial vagina and a total of thirty six blood samples, three from each of twelve Beetal bucks, collected on the day of semen collection, were used to study the correlation of serum and seminal plasma IGF-1 concentrations with semen characteristics. IGF-1 concentration was estimated in serum and seminal plasma using the ELISA kit following the standard procedure. Fresh semen attributes *viz.* ejaculate volume, mass motility, individual progressive motility, sperm concentration, sperm viability, intact acrosome, sperm abnormalities, sperm plasma membrane integrity and reactive oxygen species; and frozen semen attributes *viz.* post thaw sperm motility, sperm viability, intact acrosome, sperm abnormalities, sperm plasma membrane integrity and reactive oxygen species were evaluated following the standard procedures.

There was a highly significant positive correlation ( $r=0.4243$ ;  $p<0.01$ ) between IGF-1 concentration in serum and seminal plasma of the Beetal buck. Insulin like growth factor-1 concentration in serum had a highly significant positive correlation with sperm viability ( $r=0.554$ ;  $p<0.01$ ), acrosome integrity ( $r=0.527$ ;  $p<0.01$ ), post thaw sperm motility ( $r=0.407$ ;  $p<0.01$ ), post thaw sperm viability ( $r=0.426$ ;  $p<0.01$ ) and a significant positive correlation with post thaw acrosome integrity ( $r=0.333$ ;  $p<0.05$ ) of the Beetal buck semen. Insulin like growth factor-1 concentration in serum had a highly significant negative correlation ( $r=-0.458$ ;  $p<0.01$ ) with SOD activity in fresh semen.

There was no significant correlation between IGF-1 concentration in serum and ejaculate volume, mass motility, individual progressive motility, sperm concentration, sperm abnormality, plasma membrane integrity and post thaw sperm abnormality, post thaw sperm plasma membrane integrity and post thaw SOD activity. Insulin like growth factor-1 concentration in seminal plasma had a significant positive correlation with individual progressive motility ( $r=0.341$ ;  $p<0.05$ ) and highly significant positive

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**Department: Animal Reproduction, Gynaecology & Obstetrics**

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correlation with sperm viability ( $r=0.527$ ;  $p<0.01$ ), acrosome integrity ( $r=0.539$ ;  $p<0.01$ ), sperm plasma membrane integrity ( $r=0.464$ ;  $p<0.01$ ), post thaw sperm motility ( $r=0.644$ ;  $p<0.01$ ), post thaw sperm viability ( $r=0.643$ ;  $p<0.01$ ), post thaw acrosome integrity ( $r=0.487$ ;  $p<0.01$ ) and post thaw sperm plasma membrane integrity ( $r=0.521$ ;  $p<0.01$ ). Insulin like growth factor-1 concentration in seminal plasma had a highly significant negative correlation with SOD activity in fresh semen ( $r=-0.714$ ;  $p<0.01$ ) and frozen semen ( $p<0.01$ ) of Beetal buck.

There was no significant correlation between IGF-1 concentration in seminal plasma and ejaculate volume, mass motility, sperm abnormality, sperm concentration and and post thaw sperm abnormality.

IGF-1 in seminal plasma can be considered as biomarker for selection of buck for breeding. However, further validation using a large sample size is required.

## **Nanoemulsions for Reducing Oxidative Stress in Cryopreserved Buck Semen**

*Soihem Diana Rongmei*

ROS production during cryopreservation is inevitable which induces detrimental changes to the plasma, acrosomal and mitochondrial membrane, DNA integrity and tail of the spermatozoa. In the same line of context, anti-oxidative supplements in the semen extender are highlighted to curtail the ROS production but their efficiency rate is variable. Therefore, we hypothesized that incorporating TEYCAE with nano zinc oxide might help to reduce the oxidative stress and maintain the sperm ultrastructure during cryopreservation. With this background, the present study conducted on 24 pooled ejaculates, collected by using standard collection method (artificial vagina) from 4 Beetal bucks (A1, A2, A3 and A4) maintained at Goat Research Station, A.A.U., Burnihat. Fresh and cryopreserved seminal traits of all the 4 bucks were evaluated for routine semen analysis and statistically ( $p < 0.05$ ) best 2 bucks were selected for further study. A total of 10 pooled ejaculates were harvested from the selected two bucks and centrifuged to form the pellet and separate the seminal plasma. The pellet was treated with different concentrations of nano zinc oxide (0, 0.05, 0.1 and 0.2 mg/ml) as additives in TEYCAE and cryopreserved by following standard freezing protocol. After cryopreservation, the nano zinc oxide treated semen samples were evaluated for sperm motility, HOST-reacted sperm, live sperm, live intact acrosome and sperm abnormalities and the mean percentage were recorded as  $59.5 \pm 0.89$ ,  $66.50 \pm 0.76$ ,  $66.5 \pm 0.76$  and  $64.5 \pm 1.16$ ;  $46 \pm 0.33$ ,  $49.3 \pm 0.21$ ,  $49.7 \pm 0.21$  and  $48.5 \pm 0.30$ ;  $73.7 \pm 0.59$ ,  $78.7 \pm 0.33$ ,  $79.3 \pm 0.26$  and  $77.9 \pm 0.45$ ;  $76.3 \pm 0.55$ ,  $82.8 \pm 0.35$ ,  $84 \pm 0.21$  and  $81.9 \pm 0.73$ ;  $11.1 \pm 0.56$ ,  $10.9 \pm 0.31$ ,  $10.3 \pm 0.21$  and  $10.5 \pm 0.42$  respectively, showing significant difference between the treated and non-treated groups in all the parameters except post thaw sperm abnormalities. Biochemical test such as Superoxide dismutase (SOD) and Malondialdehyde (MDA) for non-treated and treated groups were recorded as  $0.2195 \pm 0.03$ ,  $0.7271 \pm 0.48$ ,  $0.8286 \pm 0.04$  and  $0.6651 \pm 0.04$ ;  $1.851 \pm 0.03$ ,  $1.241 \pm 0.02$ ,  $1.176 \pm 0.02$  and  $1.275 \pm 0.02$  respectively, revealing significant difference ( $p < 0.05$ ) in treated groups as compared to the control group, highlighting a significant reduction in oxidative stress in nano zinc oxide incorporated samples. The

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**Department: Animal Reproduction, Gynaecology & Obstetrics**

**Major Adviser: Dr. M. Das Gupta**

advanced fluorescent dyes technique included membrane integrity using DNA integrity using acridine orange, acrosomal integrity using FITC-PSA, sperm viability using CFDA-PI and mitochondrial membrane potential using JC-I and the recorded values were  $75 \pm 0.64$ ,  $78.5 \pm 0.61$ ,  $78.5 \pm 0.5$  and  $77.4 \pm 0.61$ ;  $62.9 \pm 0.48$ ,  $66.3 \pm 0.5$ ,  $66.5 \pm 0.57$  and  $66 \pm 1.38$ ;  $65.4 \pm 0.71$ ,  $68.4 \pm 0.58$ ,  $68.5 \pm 0.5$  and  $68 \pm 0.57$ ;  $51.2 \pm 0.38$ ,  $53.1 \pm 0.37$ ,  $54 \pm 0.21$  and  $53 \pm 0.42$  respectively for 0, 0.05, 0.1 and 0.2 mg/ml nano zinc oxide in the TEYCAE. Besides, significantly ( $p < 0.05$ ) lower DNA damage, higher live sperm, acrosome and mitochondrial health were observed in treated groups as compared to the non-treated group. On the other hand, electron microscopy (TEM) of the ultrastructure of the sperm cells detected intact nucleus, mitochondria, outer dense fiber and axoneme but ruptured and separating plasma membrane exposing the acrosome in non-treated group whereas the treated sperm showed distinct intact ultrastructure with intact plasma membrane. Although there was no significant difference among the treated groups but the concentration of 0.1 mg/ml nano zinc oxide revealed positive effect as compared to the other concentration of treatment groups. Hence, nano zinc oxide incorporated at a certain amount act as an effective antioxidant in reducing the cryo-stress and maintaining the quality of the sperm cells.

## **Performance of Hampshire Piglets Reared on Hot Water Treated Floor**

*Sweta Pachani*

A total of 6 healthy crossbred female dogs were selected to conduct the present study. Observation of physical and behavioural signs along with examination of vaginal cytology was performed on day 1-3, day 4-6, day 7-9 and day 10-12 of proestrual phase for determination of breeding time. On day 10-12 of proestrual phase swollen vulva, bloody discharge and serous discharge of physical signs were recorded as 00.00%, 16.67% and 33.33%, respectively. On the other hand, the behavioural signs of restlessness, attraction of male dog, flagging of tail and acceptance of male were recorded as 00.00%, 100, 0.00%, 66.67% and 66.67% respectively.

Vaginal cytology revealed highest number of anuclear cells ( $92.66 \pm 0.80\%$ ) and lowest number of parabasal cells ( $0.67 \pm 0.33$ ) on day 10-12 of proestrual phase. Mean level of progesterone and relaxin was significantly ( $P < 0.05$ ) found to be highest on day 10-12 and day 7-9 of proestrual phase, respectively. Value of C-Reactive Protein was significantly ( $P < 0.05$ ) the highest on day 10-12 of proestrual phase. Level of calcium was found significantly ( $P < 0.05$ ) higher than phosphorus on day 1-3, day 4-6, day 7-9 and day 10-12 of proestrual phase in crossbred bitch.

For diagnosis of pregnancy gestation period was divided into four periods and accordingly, examination was done on 0-15 days, 16-30 days, 31-45 days and 46-day of whelping.

The gestational sac was detected by using B-mode ultrasonography as early as on day  $20 \pm 0.58$  (19-21 day) and embryo was detected as early as on day  $24 \pm 0.58$  (23-25 day). Fetal Heart Beat, fetal limb buds, fetal movement, fetal head, fetal stomach, urinary bladder and fetal skeleton were detected as early as on day  $29 \pm 0.58$  (28-30 day),  $37 \pm 0.71$  (35-38 day),  $37 \pm 0.71$  (35-38 day),  $40.5 \pm 0.65$  (38-41 day),  $40.5 \pm 0.65$  (38-41 day),  $40.5 \pm 0.65$  (38-41 day) and  $43.5 \pm 0.65$  (41-45 day), respectively. The diameter of gestational sac was recorded as  $12.13 \pm 1.70$  mm on 16-30 days of gestation while on 31-45 days of gestation the crown rump length and fetal head diameter was first found to be recorded as  $55.78 \pm 9.93$  mm and  $17.48 \pm 0.50$  mm, respectively. Fetal Heart Rate could be recorded first on 16-30 days of gestation as  $227.50 \pm 0.50$  beat/minute. Level of

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progesterone and relaxin was significantly increased ( $P < 0.05$ ) in 16-30 days and 31-45 days of gestation, respectively. While, at 46-day of whelping mean level of progesterone was found to be decreased and recorded  $2.51 \pm 0.13$  ng/mL. Level of CReactive protein was significantly ( $P < 0.05$ ) increased in 16-30 days of gestation ( $97.53 \pm 1.62$  mg/L). In case of calcium and phosphorus no significant difference was observed between period of gestation. There was significant difference ( $P < 0.05$ ) between minerals. Interaction between periods x minerals revealed non-significant difference. The study revealed that breeding time can be determined by behavioural signs of flagging of tail and acceptance of male, increased level of anuclear cells in vaginal cytology, progesterone and C-Reactive Protein in blood serum. Early pregnancy can be diagnosed based on appearance of Gestational Sac, Embryo and Fetal Heart Beat between 16-30 days period of gestation.

## **Anatomical Studies on Liver and Pancreas of *Pati* Ducks (*Anas platyrhynchos domesticus*) of Assam During Post-Natal Development**

*Kulajit Kalita*

Duck is one of the most important species in poultry industry and also in intensifying farming system. Since there is very scanty literature on the detailed anatomy of liver and pancreas of *Pati* duck of Assam, hence the present study was designed to establish anatomical norms on the liver and pancreas of *Pati* ducks during post-natal development up to 24 weeks of age. The outcome of these research findings shall help physiologist, pathologist and poultry scientists for carrying out further research work as well as to develop the disease control regime.

A total of 24 ducks divided into 4 (four) groups, consisting of 6 ducks in each group according to their age were utilized in the present study and were utilized for detailed anatomical study on gross, histomorphological, histochemical, biochemical and hematological parameters.

In the current study, the gross morphometry viz. length, breadth, thickness and weight of liver and pancreas in *Pati* ducks were observed with age. Morphometrical parameters of the liver and pancreas in *Pati* ducks at different ages showed an increasing trend with increase in age. The average weight of the liver was  $3.92 \pm 0.24$  gm at 1 week and  $39.65 \pm 0.99$  gm at 24 weeks of *Pati* duck of Assam. The average weight of the pancreas was  $0.28 \pm 0.04$  gm and  $3.66 \pm 0.22$  gm at 1 week and 24 weeks of *Pati* duck respectively.

Histological study showed that the liver of *Pati* duck was covered by a thin capsule. The connective tissue of the capsule contained collagen, reticular and elastic fibers. The thickness of the capsule of the liver increased slightly along the advancement of the age. Presence of fine nerve fiber was observed in the capsule penetrating into the parenchyma through trabeculae. The lobules of liver of *Pati* ducks were not distinct due to presence of less amount of interlobular connective tissue though the connective tissue was prominent in the portal triads. Hepatocytes were arranged as branching and anastomosing cords and each hepatic cord consisted of double layers of cells. The

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**Department: Veterinary Anatomy Histology**

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spherical to ovoid vesicular nucleus of hepatocytes was observed in the basal half of the cells.

The pancreas of *Pati* was encapsulated by a thin connective tissue capsule from which trabeculae entered the parenchyma dividing that organ into a number of incomplete lobules. Pancreas parenchyma comprised of two distinct components i.e. exocrine and endocrine part. Exocrine part composed of tubulo acinar gland and endocrine part constituted of Islets of Langerhans. Two types of cells of Islets of Langerhans i.e. alpha (dark) and beta (light) were recorded. Nerve fibres were also observed in the islets within the reticular network.

Histochemical study revealed that the activity of alkaline phosphatase enzyme of liver was shown strong in 1<sup>st</sup> week and weak in 24<sup>th</sup> week age. The strong activity observed in the capsular area of the liver. The activity of the acid phosphatase was weak in all age groups. However, strong acid phosphatase activity was observed in the bile canaliculi. The ATPase activity was same in the all age groups. The activity of non specific esterase was moderate in the liver.

The activity of alkaline phosphatase enzyme of pancreas was strong in 1 week and weak in 24 weeks old age group. The overall activity of acid phosphatase enzyme was weak in all age groups of birds. However, strong acid phosphatase activity was observed in ducts. Adenosine triphosphatase and non-specific esterase activity were strong in all age group of birds.

Biochemically, The serum AST level in 1 week old duckling was  $7.91 \pm 1.06$  U/L and in 24 weeks old ducks was  $15.31 \pm 2.45$  U/L. The mean serum ALT level in 1 week and 24 weeks of age were  $12.52 \pm 1.46$  U/L and  $54.46 \pm 4.96$  U/L respectively. The average serum ALP level in 1 week old ducklings was  $64.33 \pm 4.70$  U/L and in 24 weeks old ducks was  $17.00 \pm 3.59$  U/L. The mean serum GGT level in 1 week old ducklings was  $3.96 \pm 1.08$  U/L and in 24 weeks old ducks was  $4.44 \pm 1.73$  U/L. All the biochemical parameters showed highly significant difference between the various age groups.

The average Red Blood Cell count of *Pati* duck in 1 week was  $2.82 \pm 0.16$  million/mm<sup>3</sup> and 24 weeks of age was  $2.83 \pm 0.38$  million/mm<sup>3</sup>. The WBC count was found significantly ( $P < 0.01$ ) lower at 1 week of *Pati* duck as compared to the other age groups. The average value of Hemoglobin in 1 week and 24 weeks of age were  $7.63 \pm 0.17$  g/dl and  $11.43 \pm 0.21$  g/dl respectively. The average concentrations of PCV in 1 week was  $37.12 \pm 1.26$  % and 24 weeks of age was  $42.7 \pm 0.81$  %.

From the present investigation it might be inferred that most of the parameters under study showed a significantly higher values between the various groups of *Pati* ducks under study. This might be due to the various anatomical, biochemical and physiological changes in body pertaining to growth with the advancement of age in *Pati* ducks.



## **Sub Clinical Mastitis in Buffalo and Its Therapeutic Management**

*Chainmoy Sarma*

The present study “Sub clinical Mastitis in Buffalo and its therapeutic management” was under taken with an objective to estimate the prevalence, etiology, diagnosis of sub clinical mastitis (SCM) and to evaluate the therapeutic potential of three different herbal regimens and also a compare the therapeutic efficacy, cost with available antibiotic on SCM in buffaloes in and around Kamrup (rural) and Nagaon Districts of Assam during the period from December 2021 to July 2022. Total of 528 quarter milk samples from 132 buffaloes were screened for sub clinical mastitis by Modified California Mastitis test (MCMT). The recorded prevalence was animal wise 68.93% and quarter wise was 29.35%, respectively. Age wise prevalence was highest in buffaloes aged between 5-7 years (79.71%) and lowest in >7 years (37.50%) of age. Further, highest prevalence was recorded in organized farms(79.41%) compared to unorganized farms(65.30%).

Highest incidence of SCM was recorded in murrah buffalo (77.55%) compared to Luit (native breeds) (63.85%). In relation to lactation number prevalence was highest during 4th (87.50%) lactation and was least in first lactation(33.33%) . According to stage of lactation, late lactations was having more prevalence per cent (75.00%). Prevalence of SCM was highest in right- hind quarters (15.10%) followed by right-fore quarters (10.98%) and was least in left-fore (6.31%) by taking single quarter into consideration. Out of 528 quarter milk samples, 155 were found positive in bacterial culture and among these 54 (34.83%) were pure Staphylococcus spp. colonies, 20 (12.90%) for Streptococcus spp., 26 (16.80 %) for Escherichia coli, 10 (6.45%) for Bacillus spp.,. 15 numbers of sample having Staphylococcus spp. + E. coli. (9.70%) ,whereas 14 numbers sample was having Escherichia coli + Streptococcus spp. (9.02%) and combined infection of Bacillus spp + Streptococcus spp. was found in 16 samples with 10.32% of prevalence .

In the In-vitro drug sensitivity test of the positive sample revealed that enrofloxacin, ceftriaxone, cefoperazone, amoxicillin was sensitive with 96.19%,

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**Department: Veterinary Clinical Medicine, Ethics and Jurisprudence**

**Major Adviser: Dr. Ditul Barman**

97.14%, 96.19% ,96.19% respectively. In the study of antibacterial property of *Ocimum sanctum*, *Moringa oleifera* leaves extract and *Curcuma longa* root extract *Moringa oleifera* extract showed highest zone of inhibition at a concentration of 30mg/ml, followed by at 10mg/ml. Similarly, *Ocimum sanctum* extract showed highest zone of inhibition at 50mg followed by at 40mg , 30mg and also *Curcuma longa* also showing maximum zone of inhibition at 200 mg/ml, followed by 100 mg/ml, 50 mg/ml.

Sub clinically affected buffaloes were randomly divided into 5 groups comprising 10 buffalo; viz: Group I, Group II, Group III, Group IV and Group V. Group I was treated with a paste of 100g of *Moringa olifera* leaves, 10g of *Curcuma longa* powder was applied topically over the udder twice daily for 7 days and feeding of aqueous extract of *Ocimum sanctum* @ 150 mg/kg body weight orally for seven days. In group II was administered with Enrofloxacin @ 4 mg/kg b.wt. intramuscularly daily for 5 days. Group III was treated with antibiotic Enrofloxacin 4 mg/kg b.wt. intramuscularly daily for 5 days and prepared extract of *Ocimum sanctum* @ 150 mg/kg body weight, orally daily for 7 days and topical application of 100g of *Moringa olifera* leaves , 10g of *Curcuma longa* powder paste twice daily for 7 days. Group IV was treated with 100g of prepared paste of *Moringa oleifera* leave topically twice daily for 7 days and the group V was treated with Intramammary infusion with antibiotic ( procaine penicillin (Pendristin- SH , Twice a day for 3 days)

The mean values of SCC, pH, EC was significantly higher ( $P<0.01$ ) in all the samples along with significant low in milk production as compared to healthy control group. In the post therapeutic regimen aafter 7 days, the mean value of SCC, EC and pH were significantly ( $P<0.01$ ) decreased in the Group I,II, III and V but not decreased in group IV where only *Moringa oleifera* leaves paste applied topically. On day 7th The mean values of milk yield did not increased significantly in group II and group V where only antibiotics were applied. In group I and group III the mean value of milk yield was significantly increased after 7th day of treatment . The ean values of SCC,pH , EC came to normal in group IV after 14 days of treatment.

In the analysis of cost per therapeutic regimen, it was observed that Group I comprises with the treatment of a paste of 100g of *Moringa olifera* leaves, 10g of *Curcuma longa* powder was applied topically over the udder twice daily having a cost of Rs. 135.00. In Group II a cost of Rs.3164.00 was observed where Enrofloxacin @ 4 mg/kg b.wt. adminsterd intramuscularly daily for 5 days. A cost of Rs.3299.00 was observed for Group III where antibiotic Enrofloxacin 4 mg/kg b.wt. intra muscularly daily for 5 days and prepared extract of *Ocimum sanctum* @ 150 mg/kg body weight, orally daily for 7 days and topical application of 100g of *Moringa olifera* leaves , 10g of turmeric powder paste twice daily for 7 days. On the other hand Rs.0.00 was cost for Group IV where only 100g of prepared paste of *Moringa oleifera* leave topically twice daily for 7 days. In Group V the cost was Rs. 2190.00 treated with Intra mammary infusion with antibiotic ( Pendristin-SH , Twice a day for 3 days).

## **Anthelmintic Activity of *Acorus calamus* Rhizome Extract Against *Haemonchus* Species in Goats**

*Champa Sharma*

The present investigation was carried out with the view to study the anthelmintic activity of *Acorus calamus* rhizome extract against *Haemonchus* species in goats. *Haemonchus contortus* worms were found to be the predominant worm in the goat population of the farm.

The qualitative phytochemical analysis of hydroethanolic extract of *Acorus calamus* rhizome revealed the presence of terpenoids, steroid, diterpines, flavonoids, tannin, glycoside, saponin and phenolic compound.

In *in-vitro* study, *Haemonchus* worms were exposed to different concentration of hydroethanolic and aqueous extract of *Acorus calamus* rhizome. The hydroethanolic extract was found to be more effective against *Haemonchus contortus* than aqueous extract. A dose dependant anthelmintic activity was exhibited by rhizome extract and highest efficacy was observed at 1000 µg/ml.

The goats positive for *Haemonchosis* showed a significant decrease in Hb, PCV, TEC, total serum protein, albumin A:G ration and serum iron and a significant increase in TLC, neutrophil and eosinophil percentage and liver enzymes (ALT and AST).

*In-vivo* anthelmintic study of hydroethanolic extract of *Acorus calamus* rhizome @ 500 mg/kg b.wt. orally (two doses, 0 day and 21<sup>st</sup> day) and fenbendazole @ 5 mg/ kg b.wt. orally were given to *Haemonchus* infected goats. EPG count, haemato-biochemical parameters and clinical improvement were evaluated on '0', 7<sup>th</sup>, 14<sup>th</sup>, 21<sup>st</sup> and 28<sup>th</sup> day post treatment. In Group I, EPG became 0 on 28<sup>th</sup> day after administration of second dose on 21<sup>st</sup> day. In Group II, treated with fenbendazole, EPG count became 0 on 7<sup>th</sup> day. Haematological parameters showed increase in Hb, PCV, TEC, lymphocyte % and decrease in TLC, neutrophil and eosinophil % post treatment and biochemical analysis showed increase in values of TSP, Serum Albumin, A:G ratio and Serum Iron after treatment. Globulin, ALT and AST values decreased significantly post treatment.

On the basis of reduction of EPG count and haemato-biochemical changes, the therapeutic efficacy of hydroethanolic extract of *Acorus calamus* rhizome was 100% on 28<sup>th</sup> day post treatment with administration of second dose orally on 21<sup>st</sup> day. Fenbendazole showed a higher efficacy with 100% reduction of EPG on 7<sup>th</sup> day post treatment.

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**Abstract of M.Sc. thesis**

**Department: Veterinary Clinical Medicine, Ethics and Jurisprudence**

**Major Adviser: Dr. Bendangla Changkija**

## **Sub-Clinical Mastitis in Dairy Cow and Its Therapeutic Management**

*Gaurab Kafle*

The present study entitled “SUBCLINICAL MASTITIS IN DAIRY COW AND ITS THERAPEUTIC MANAGEMENT” was done for a period of 8 months viz. from December 2021 to July 2022 with the objectives to study the prevalence, etiology, diagnosis of subclinical mastitis (SCM), antibiogram of the isolates and to evaluate the therapeutic efficacy of three different treatment regimen on SCM in dairy cows in private dairy farms located in and around Guwahati city. Total 508 quarter milk samples from 127 dairy cows were screened for SCM by Modified California mastitis test (MCMT) and recorded animal wise, quarter wise prevalence as 67.71 and 28.34 per cent, respectively. Age wise prevalence was recorded highest in cows aged between >5-7 years (70 per cent), whereas lactation wise prevalence was recorded highest in the cows in fourth lactation (72.72 per cent) and least in first lactation (58.82 per cent). Similarly, prevalence of SCM was found higher in late stage of lactation (71.42 per cent) as compared to mid (70.45 per cent) and early stage of lactation (60.97). The right hind quarter (33.07 per cent) and the left hind quarter (28.34 per cent) were mostly affected as compared to other two quarters. The quarter wise prevalence of subclinical mastitis was recorded highest in single quarter followed by two quarters, four quarters and least in three quarters with 33.07 per cent, 28.34 per cent, 4.7 per cent, and 1.57 per cent respectively. A total of 164 bacterial isolates were obtained from 508 quarter milk samples, Staphylococcus spp. was found as the most prevalent organism (65.24 per cent) followed by Streptococcus spp. (9.14 per cent), Escherichia coli (32.31 per cent) and Klebsiella spp. (1.82 per cent). Enrofloxacin was found to be most effective antimicrobial drug against the isolates followed by ceftriaxone, cefaperazone, oxytetracycline and amoxicillin.

Before treatment mean values of SCC and pH in group A, B and C were significantly high ( $P<0.001$ ) when compared to healthy control group, whereas fat and SNF were significantly ( $P<0.001$ ) low. However, after therapy the mean value of SCC and pH were significantly ( $P<0.001$ ) decreased whereas, fat and SNF increased

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**Abstract of M.Sc. thesis**

**Department: Veterinary Clinical Medicine, Ethics and Jurisprudence**

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significantly ( $P < 0.001$ ). Therapeutic regimen of group A viz. HTM injection (A, E and iodine) along with antibiotic therapy was found more effective and helped the affected cows to recover early as compared to group B viz. Levamisole HCl and antibiotic and group C viz. mineral mixture and antibiotic.

## **Osteomalacia : Its Diagnosis and Management in Dairy Cows**

*Gunajit Barman*

A total of 325 dairy cows of private dairy farms in and around Guwahati city and Instructional Livestock Farm, College of veterinary science, Assam Agricultural University, Khanapara, Guwahati-22 were screened and 23 cows were confirmed positive for osteomalacia on the basis of clinical symptoms and biochemical parameters. The prevalence of Osteomalacia was recorded 7.08 per cent with the highest distribution in the age group of >6-9 years (47.82%), followed by >3-6 years (34.78%), >9 years (13.04%) and < 3 years (4.35%). The highest distribution of osteomalacia was found between 4th-6th lactation and lowest in >6th lactation.

The clinical symptoms of osteomalacia recorded in this present study were lordosis, kyphosis, bowing of legs, difficulty in getting up, reduced body conditions. The positive cows showed low levels of serum calcium (7.60 to 8.90 mg/dl), phosphorus (1.82 to 3.76 mg/dl) and vitamin D3 (15.31 to 31.72 ng/ml) and high rise of serum alkaline phosphatase enzyme (182.9 to 286.2 Unit/L). The hock angles were also lower than the healthy animals.

In the therapeutic trial the treatment regimen for cows of group A, that were administered buffered phosphorus injection @ 25 ml intravenously to each animals followed by calcium, phosphorus and vitamin D3 supplementation (Calphos D3 bolus) @ 1 bolus twice daily for 30 days was found to be more effective than the others.

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## **Studies on Anthelmintic Efficacy of *Zanthoxylum armatum* Against Gastrointestinal Parasites of Goat**

*Jakir Hussain*

The present investigation was carried out to study the anthelmintic efficacy of hydroethanolic seed extract of *Zanthoxylum armatum* against gastrointestinal parasites of goats. The overall prevalence of gastrointestinal parasites in goats was recorded to be 65.41% under prevailing agro-climatic conditions of Goat Research Station, AAU, Burnihat and private farms in and around Guwahati city, Assam from January- March 2021 & September - November 2021. Out of the different gastrointestinal parasites recorded in goats the prevalence of *Haemonchus* spp. (54.14%) was found to be the highest and *Trichostrongylus* spp. (18.78%) the lowest. In most of the animals, mixed infestations with 2-3 types of gastrointestinal parasites were also recorded.

Phytochemical analysis of hydroethanolic seed extract of *Zanthoxylum armatum* revealed the presence of alkaloid, terpenoid, diterpene, flavonoid, steroid, glycosides, saponin and phenolic compounds but it was found negative for tannin. The acute oral toxicity study in mice showed that the hydroethanolic seed extract of *Zanthoxylum armatum* is safe up to 2000 mg/kg body weight when administered orally. *In-vitro* study of hydroethanolic seed extract of *Zanthoxylum armatum* showed dose-dependent and time-dependent anthelmintic activity and the highest efficacy was observed at 1000 µg/ml against adult parasite of *Haemonchus contortus* at 60 minutes.

Based on the reduction of EPG count in the present study, Group A, animals which were treated with hydroethanolic seed extract of *Zanthoxylum armatum* @250 mg/kg body weight, orally and repeated on the 21<sup>st</sup> day showed the highest efficacy on post-treatment days i.e. 100% on the 28<sup>th</sup> day followed by the animals in Group C, treated with hydroethanolic seed extract of *Zanthoxylum armatum* @125 mg/kg body weight and ethanolic seed extract of *Butea frondosa* @ 50 mg/kg body weight, Group B, treated with hydroethanolic seed extract of *Zanthoxylum armatum* @125 mg/kg body weight and methanolic seed extract of *Entada phaseoloides* @250 mg/kg body weight and Group D, treated with hydroethanolic seed extract of *Zanthoxylum armatum* @125

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mg/kg body weight, methanolic plant extract of *Entada phaseoloides* @250 mg/kg body weight and ethanolic seed extract of *Butea frondosa* @50mg/kg body weight, orally and repeated on 21<sup>st</sup> day.

The *In-vivo* study showed that the hydroethanolic seed extract of *Zanthoxylum armatum* individually or in combination with methanolic seed extract of *Entada phaseoloides* and ethanolic seed extract of *Butea frondosa* were effective against gastrointestinal parasites of goats. Based on the improvement in body weight and haemato-biochemical parameters with reduction of EPG of faeces it was observed that hydroethanolic seed extract of *Zanthoxylum armatum* was more effective as anthelmintic when used alone than in combination against gastrointestinal parasites of goats.



# **L Inico-Haematobiochemical and Therapeutic Management of Anaemia Associated with Chronic Kidney Disease (CKD) in Dog**

*Pradyout Pallav Hazarika*

The present study entitled “CLINICO-HAEMATOBIOCHEMICAL AND THERAPEUTIC MANAGEMENT OF ANAEMIA ASSOCIATED WITH CHRONIC KIDNEY DISEASE (CKD) IN DOGS” was done for a period of 10 months viz. from October 2021 to July 2022 with the objectives to study the prevalence of anaemia and associated clinical and haemato-biochemical alterations in dogs presented at Veterinary Clinical Complex (VCC), College of Veterinary Science, Khanapara, Assam, and to evaluate the comparative therapeutic efficacy of recombinant human erythropoietin (rHuEPO) and parenteral iron alone or in a combination along with conservative therapy in anaemic dogs associated with CKD.

The study revealed overall prevalence of 43.55% anaemia with higher prevalence in Mongrel (56.13%), male predominance (47.12%) and in age group of >6-10 years (64.63%). Clinical signs associated with anaemia were hypothermia, tachycardia, tachypnoea, pale mucous membrane, increased capillary refill time, anorexia, diarrhoea, halitosis, dental tartar and melena. Haemato-biochemical assessment revealed a normocytic normochromic anaemia with a significant decrease in the values of Hb, PCV and TEC in anaemic dogs. Hypoproteinemia and hypoalbuminemia with a significantly increased BUN, serum creatinine, ALT, AST and total bilirubin were also observed in anaemic dogs.

The prevalence of anaemia associated with CKD was found to be 3.11%. Nephrosonogram of affected dogs revealed hyperechoic and hypoechoic thick renal cortices with partial to complete loss of cortico-medullary differentiation along with hyperechoic medullary rim, mild to complete loss of renal parenchyma and moderate to complete capsular disorientation. Proteinuria along with significant elevation in UPCR and significant decrease in urine creatinine was recorded in affected dogs. Haematobiochemical assessment revealed normochromic normocytic anaemia, hyperproteinemia, hyperalbuminemia and hyperphosphatemia along with significant

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elevation of BUN, serum creatinine, ALT, AST and total bilirubin in anaemic dogs associated with CKD. Combination of rHuEPO and parenteral iron along with conservative therapy was found to be more effective in the therapeutic management of anaemia associated with CKD with a survival rate of 75% (28 days) when compared to rHuEPO and parenteral iron given alone along with conservative therapy.

## **Congestive Heart Failure in Dogs and Its Therapeutic Management**

*Prerona Patowary*

The present study entitled “Congestive heart failure in dogs & its therapeutic management” was undertaken w.e.f. 1<sup>st</sup> November 2020 to 30<sup>th</sup> June 2021 with the objectives to study the prevalence, hemato-biochemical alterations & efficacy of different therapeutic regimens of congestive heart failure in dogs. The study revealed overall prevalence of 0.20% with highest prevalence in Labrador retriever breed (0.53%) with male predominance (0.22%) and in the age group of >10 years of age (0.50%). The observed clinical signs included exercise intolerance, dyspnoea, coughing, ascites, syncope, inappetance and weakness. Tachycardia crackles and murmurs were the common clinical findings in the CHF affected dogs. ECG findings in CHF affected dogs included sinus tachycardia (37.50%), sinus bradycardia (8.33%), sinus arrhythmia (25%), sick sinus syndrome (8.33%), 1<sup>st</sup> degree heart block (8.33%), atrial fibrillation (12.50%), atrial flutter (4.17%) and low voltage QRS complex (12.50%). Radiographic findings of CHF included cardiomegaly (87.50%), upward deviation of trachea (33.33%), pleural effusion (70.83%) & pericardial effusion (25.00%) with significantly elevated VHS. Ultrasonography of abdomen showed presence of ascites (66.67%), hepatic congestion (75.00%), hepatomegaly (62.50%), renal degeneration (41.67%), splenomegaly (12.50%) and cystitis (8.33%). Echocardiographic findings in CHF were DCM (75.00%), Cardiomegaly (83.33%), mitral valve regurgitation (91.67%), tricuspid valve regurgitation (41.67%), and pericardial effusion (25.00%). The LVIDd, LVIDs, EPSS, LA/AO dimensions were increased with a decrease in IVSd, IVSs, LVPWd, LVPWs and contractility indices (EF and FS) in affected dogs. There was a significant mosaic pattern appearance on color flow doppler found in mitral & tricuspid valve regurgitation.

Hematological assessment showed no significant changes. Serum biochemical assessment showed significant increase in the level of SGOT, SGPT, BUN, serum creatinine and LDH. Moreover significant decrease in the level of total serum protein and albumin was recorded.

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All the CHF affected dogs were divided into three groups, viz: group A, B and C each having 8 numbers of dogs. Dogs in group A treated with furosemide + spiranolactone, pimobendane and ramipril orally daily. Dogs in group B treated with hydrochlorothiazide + spiranolactone, pimobendane and ramipril orally daily. Dogs in group C treated with torsemide + spiranolactone, pimobendane and ramipril orally daily. All the dogs under treatment for 42 days were monitored and the efficacy was assessed at fortnight intervals based on improvement of clinical signs, hemtobiochemical alterations, ECG, thoracic radiography, USG of abdomen and echocardiography features. There was a significant improvement in the serum biochemical parameters of CHF dogs during therapy. Radiographically, no appreciable reduction in heart size was observed in any of the CHF dogs after 42days of therapy except substantial reduction in the pleural & pericardial effusion. There was improvement & disappearance of cardiac arrhythmia in ECG. A significant difference in left ventricular dimensions (LVIDd, LVIDs, IVSd, IVSs, LVPWd, LVPWs and EPSS) and contractility indices ( EF and FS) were noticed in affected dogs by the end of the trial.

Based on resolution of clinical signs, improvement in hemato-biochemical alterations and echocardiographic features it was found that a combination of torsemide + spiranolactone, pimobendane and ramipril was found superior to other two combinations as indicated by faster disappearance signs and early recovery with no adverse drug reaction both during and after therapy. Hence this therapeutic regimen is indicated in dogs with congestive heart failure.

## **Evaluation of Salivary Biomarkers for Chronic Kidney Disease in Dogs**

*Tanu Sharma*

The present study entitled “Evaluation of salivary biomarkers for chronic kidney disease in dogs” was done for a period of 6 months i.e., February, March, April, September, October and November 2021 with the objective to evaluate and correlate the levels of salivary and serum creatinine and urea in dogs with CKD. The prevalence of CKD in dogs was 0.25%. The highest breed distribution was recorded in Labrador (44.74%); highest distribution was seen in dogs between >6-10 years of age (52.63%) and was predominant in male dogs (60.53%). Most prominent clinical signs of CKD observed were inappetance (84.21%), vomiting (57.89%), oral manifestations (55.26%), pale mucous membrane (34.21%), lethargy/depression (28.95%), congested mucus membrane (23.68%), polyuria/polydipsia (15.79%), weight loss (15.79%), diarrhoea (7.89%), and anuria (2.63%). The most prominent oral manifestations observed were halitosis (26.31%) followed by dental tartar (18.42%), dental carries (7.89%) and oral ulcer (2.63%). Haemoglobin and Packed cell volume was significantly lower in dogs with CKD. Ultra-sonographic changes observed in the kidneys of dogs suffering from CKD were hyper-echoic and thick renal cortex, partial or complete loss of corticomedullary differentiation, wrinkled capsule and hyper-echoic medullary rim. Serum and salivary concentration of creatinine and urea were significantly higher in dogs with CKD. A positive correlation between salivary and serum creatinine and salivary and serum urea was noted. Salivary biomarkers (creatinine and urea) were found to be almost equally sensitive and specific when compared to serum biomarkers (creatinine and urea) in reflecting kidney disease. Cut off value of salivary creatinine was 0.89 mg/dl and salivary urea was 18.50 mg/dl.

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## **Transmission of Newcastle Disease Virus at Domestic-Wild Bird Interface**

*Abhilasha Sharma*

Wild birds have been known to be reservoirs of Newcastle disease virus and the disease has been identified as one of the endemic diseases in India despite vaccination. Moreover, wildlife-livestock interfaces have come into light as the most overlooked areas of disease emergence. In that context, to demonstrate and establish spillover and spillback of Newcastle disease virus in wild and domestic birds as well to identify epidemiological means facilitating transmission at interface areas, a study was undertaken to detect and characterize NDV in the pool maintained in wild and domestic birds along with some epidemiological studies. Samples were collected from a total of 321 birds, both wild (n=81) and domestic (n=240) and subjected to haemagglutination inhibition (HI) and RT-PCR. The apparent prevalence of NDV in wild birds was found to be 22.2% (95% CI: 13.2-31.3%) and 14.6% (95% CI: 10.1-19.1%) in domestic birds at the sampled areas in this study from April, 2021 to August, 2022 revealing that wild birds had a higher likelihood of being affected with NDV than that of domestic (OR=1.67, 95% CI: 0.89-3.16, P=.101). The highest proportion of NDV positive wild birds were from the interface areas of Kaziranga National Park (32.21%) and in domestic birds from the interface areas of Assam State Zoo (25%). The study revealed that NDV positive cases in were highest among the raptors in wild (56.3%) and granivores (7.78%) in case of domestic birds. 14.3% and 4% of the sampled swabs collected from wild (n=56) and domestic birds (n=151) respectively to be positive for NDV thereby illuminating the dominant shedding nature of the virus. Similarly, 23.9% and 12.6% of the sampled tissues collected from wild (n=67) and domestic birds (n=261) were found to be positive for the virus. Additionally, it was found that in wild birds, highest proportion of NDV detection was seen in winter (44.44%) whereas in domestic birds, it was seen highest in pre-monsoon season (31.42%). Furthermore, detection of NDV was found to be significantly correlated with species and colony of birds as well as with the type of samples collected. A total of 11 NDV isolates from wild (n=6) and domestic birds (n=5) were subjected to biological and molecular pathotyping on the basis of MDT and FPCS respectively. MDT for NDV isolates of wild birds

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ranged between  $31.02 \pm 2.98$  to  $48.56 \pm 2.79$  and  $40.67 \pm 2.03$  to  $59.01 \pm 0.77$  for NDV isolates of domestic rendering them to be of velogenic nature. Molecular pathotyping based on F protein cleavage site motif revealed the 11 isolates from both wild and domestic birds to be of the virulent nature with 112RRQKRF117 amino acid sequence at their F protein cleavage site. Representative NDV isolates from wild (n=6) and domestic (n=5) were sequenced and subjected to phylogenetic analysis which revealed all the wild isolates to be clustered under genotype VII in class II NDV, whereas isolates from wild birds were grouped under both genotype VII and XIII. A questionnaire survey was conducted to evaluate the risk factors enabling transmission of Newcastle disease virus at interface areas. Analysis of risk factors associated with NDV transmission showed that change in weather had 37 times significantly higher risk of mass mortality of Newcastle disease than that of no changes in weather, OR=37 95% CI :9.34- 146.65,  $P < .001$ . Similarly, farms in close proximity significantly had higher chances of NDV affection, OR=3.96 95% CI :1.38-11.36,  $P = .008$ . The presence of waterbody nearby had a 5.11 times higher risk of being exposed to NDV than absence of waterbody nearby, OR=5.11 95% CI :1.78-14.67,  $P = .002$ . Other animals housed in the premises was also a significant risk factor, OR=3.87 95% CI :1.45-10.33,  $P = .006$ . Linear regression analysis revealed risk factors including mortality after weather change, presence of water body nearby, unavailability of clean drinking water, unavailability of chlorinated water, not practising all-in-all-out system; not practising down-time, interaction of other birds while feeding, mixing with neighbourhood ducks and geese, being housed with pigeons, deworming not carried out, no use of foot-baths, biosecurity not followed, being housed with pigeons, presence of bamboo groves in the farm, crows visiting the farm, predation by rodents, wild birds interacting while feeding and seasonal migration of wild birds observed nearby to be significant risk factors at flock level. Knowledge and attitudes were found to have positive correlations with practices adopted by bird owners. A statistically insignificant link was found between knowledge and attitudes, but a positive trend line was observed between the two. The derived data base regression explained about 36.82% of total variation in practice.

## **Management of Clostridial Infection with Special Reference to *Clostridium perfringens* in Asiatic Elephant (*Elephas maximus*) in Assam**

*Ashit Chakraborty*

Clostridial infection is an anaerobic Gram +ve bacterial disease of both wild and captive elephant. This organism is generally recorded in deep seated wound infection. A total number of 40 elephants were examined during the study period with 10 wild and 30 captive elephants. 8 numbers of *Clostridium perfringens* were isolated from different types of sample which were found to be positive for *cpa* gene after PCR analysis confirming the isolates to be of *Clostridium perfringens* Type A with highest prevalence from Intestinal content (50.00%) and one number of *Clostridium difficile* was isolated from faecal sample which was found to be positive for *gluD* gene with a prevalence of 4.16 per cent.

The prevalence of Clostridial infection in wild elephant was 20.00 per cent and in captive elephant 23.33 per cent with the overall prevalence of 22.50 per cent. The prevalence of Clostridial infection as per spatial distribution in captive elephant of Forest Department (Govt. of Assam) was 23.33 per cent. However, in wild the highest prevalence was recorded in Rani Forest Reserve. Season-wise the prevalence was higher during rainy season (40.00%) and lower in summer (13.33%). Age-wise prevalence was highest in less than 10 years of age group (40.00%) and lower in age group above 51 years (10.00%). Sex-wise the prevalence was found to be highest in wild male elephants (50.00%).

There was an increase in total leucocyte count (TLC), neutrophil and monocyte level with decreased level was observed in haemoglobin (Hb), red blood cell (RBC) and packed cell volume (PCV) in Clostridial infected elephants. *Clostridium perfringens* and *Clostridium difficile* were the two *Clostridial* species, isolated from different samples. The antibiogram test showed highest sensitivity to Enrofloxacin, Cefotaxime and Gentamicin whereas partial resistance to Ceftriaxone and Tazobactam, Tetracycline.

Therapeutic management of deep-seated wound infection was done with potassium permanganate solution (1:1000) and dressed with povidone iodine (5%)

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solution. Topical antiseptic cream (Charmil ointment) was applied over the wound for 10-15 days along with Enrofloxacin (Flobac SA) injection. Vitamin B complex (Conciplex) and meloxicam (Melonex) injection was given as a supportive therapy. The elephants showed recovery within 20-24 days. The *Clostridium difficile* isolated from faeces of the affected elephant was rendered treatment with Cefotaxime (Taxim) injection. Intalyte, Vitamin B complex (Conciplex) and meloxicam (Melonex), and iron (Ferritas) injection was given as supportive therapy. Unfortunately the calf died during the course of treatment due to several other concurrent infections.

## **Epidemiology and Economic Impact of Rabies in Animals of Kamrup Metro District of Assam and West District of Tripura**

*Bishal Debbarma*

Rabies is a neglected tropical fatal viral zoonosis caused by *Lyssavirus* genus of *Rhabdoviridae* family, mostly mediated by dog-bites. It is 100 per cent preventable by timely and appropriate post-exposure prophylaxis (PEP). Globally 60,000 people die from canine-mediated rabies annually. India reports approximately 30 per cent of global burden annually. The economic impact of rabies on farmers includes the post-exposure expenses of vaccination and/or losses due to livestock mortality. In the present study, post-mortem brain tissue samples were collected from three different locations as per OIE for diagnosis of rabies using Lateral Flow Assay (LFA) kit, and confirmed by Direct Fluorescent Antibody Technique to determine the incidence of rabies. The economic impact was analysed on disability-adjusted life years (DALYs) and total cost of PEP of dog-bite cases from the retrospective data for five years. The incidence of rabies was 76.47 per cent in animals in the present study. Species-wise, canines (76.92%) had the highest incidence of rabies followed by bovine (15.38%) and caprine (7.69%). Retrospective study for five years (2016-2020) revealed 1093 and 1735 dog-bite cases in the Veterinary Clinical Complex (VCC), CVSc, AAU, Khanapara and the State Veterinary Hospital (SVH), Chenikuthi, Kamrup Metro of Assam, respectively. On the other hand, 655 dog-bite cases were recorded in the State Veterinary Hospital (SVH), Abhoynagar, West district of Tripura during 2019 and 2020. The incidence of dog-bite cases were recorded highest in 2019 in all the three hospitals. Month-wise, August and October recorded the highest dog-bite cases. Gender-wise, dog-bite cases were higher in males (57.63%) than females (43.37%). The cost of PEP per dog-bite case was estimated at Rs. 215-703, Rs. 171-536 and Rs. 161-610 for VCC, SVH (Chenikuthi) and SVH (Abhoynagar) respectively. For 4-dose regimen (Essen regimen) PEP, the cost per dog-bite case ranged from Rs. 860-2,812, Rs. 684-2,144 and Rs. 644-2,440 for the same hospitals, respectively. The total cost of 4-dose regimen PEP for the VCC ranged between Rs. 939,980-3,073,516 while for the SVH, Chenikuthi, it ranged

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between Rs. 1,186,740-3,716,960 for the years under study. On the other hand, 4-dose regimen PEP cost for the SVH, Abhoynagar, it ranged between Rs. 421,820-1,598,200 for two years (2019-2020). The disability-adjusted life years (DALY) for 2019 was between 6200-6210 days in bovine, 35,469-35,559 days in canine and 4,740-4,750 days in caprine with 11 mortalities. The DALY for 2020 ranged between 7112.5-7122.5 days in bovine and 3800-3810 days in canine with 2 mortalities due to rabies. Estimating the actual burden of rabies is a priority for devising control and prevention strategies.

## **Detection and Genotypic Characterization of Rotavirus in Dog and Its Management**

*Chayanika Mazumder*

Rotavirus (RV) has been recognized as an important enteric pathogen of many species, including human and dogs. The study has been undertaken to detect rotaviral antigen from faecal samples of dogs and to characterize G and P genotypes from positive samples along with the management of the rotavirus induced diarrhoea in dogs. A total of 157 faecal samples were collected aseptically from dogs with gastroenteritis with effect from November, 2020 and December, 2021. All the samples were screened for the presence of rotavirus by using ribonucleic acid-polyacrylamide gel electrophoresis (RNA-PAGE) and rotavirus by reverse transcriptase-polymerase chain reaction (RT-PCR). Rotavirus positive samples were further analyzed by nested-multiplex RT-PCR for detection of G and P genotypes in dog.

Canine rotavirus (CRV) was detected in 8 samples out of 157 diarrhoeic faecal samples by RNA-PAGE. The incidence of canine rotavirus infection was 5.09% by RNA-PAGE. RNA-PAGE positive samples revealed migration pattern of 4:2:3:2 in 4 different clusters, indicating group A rotavirus.

Out of 157 diarrhoeic faecal samples processed for amplification of VP6 gene of rotavirus, 17 samples were found to be positive for canine rotavirus by RT-PCR. The incidence of canine rotavirus infection was 10.83% by RT-PCR. In the study, pups less than 3 months of age were found to be more susceptible to the CRV infection (16.25%). The incidence was higher in male (12.79%), but statistically there was no significant difference ( $p > 0.05$ ) in relation to the age and sex.

Genotypic characterization of rotavirus by nested multiplex RT-PCR, revealed presence of G3 (10/17, 58.82%) genotypes in G-genotyping and P[3] (7/17, 41.18%) genotypes in P-genotyping. Thus, the distribution of G-P genotype during the study was found to be G3P[3] combination.

A significant increase of haemoglobin (Hb), packed cell volume (PCV), Total erythrocyte count (TEC), monocyte, lymphocyte, aspartate aminotransferase (AST), alanine aminotransferase (ALT), Blood urea nitrogen (BUN) and creatinine (cr), while

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significant decrease of total leukocyte count (TLC), neutrophil, total protein (TP), sodium (Na), potassium (K) and chloride (Cl) were recorded in RV infected dogs.

Management of RV infected dogs were done with conventional therapy comprising of fluid therapy viz. NS/RL/DNS, antiemetic (Ondansetron), antibiotic (Ceftriaxone), acid blocker (pantoprazole), multivitamin/vitamin B complex (Tribivet) and haemostatic (Botropase) through intravenous route. After treatment, all the infected dogs recovered completely and all the haemato-biochemical parameters have reached almost to the normal values of control group.

# **Epidemiological Study and Economic Impact of African Swine Fever in Few Affected Districts of Assam**

*Jahnabi Doley*

African Swine Fever (ASF) is a highly contagious and economically devastating important viral disease, causing 100 per cent mortality in domestic pig irrespective of breed, age and sex. The present study was undertaken to identify the epidemiological determinants of ASF, its sero-surveillance and the economic impact of the disease on pig farmers of three affected districts of Assam, i.e., Lakhimpur, Dhemaji and Majuli, during the period of October 2021 to August 2022. Assessment of risk factors associated with the outbreaks of ASF revealed presence of 'kutcha' (earthen) floors ( $p<0.01$ ), free-range rearing system ( $p<0.01$ ), biosecurity practices like allowing entry of visitors into the farm ( $p<0.01$ ), presence of weekly market within 2.5km proximity of the farm ( $p<0.01$ ), and pig slaughter point less than 1 km vicinity of the farm ( $p<0.01$ ), was found to have high significant association. Factors like swill feeding ( $p<0.05$ ), non-usage of disinfectants ( $p<0.05$ ), presence of households or farms within 500m distance ( $p<0.05$ ) and river within 1 km range of the farm ( $p<0.05$ ), farmers unawareness regarding the clinical signs of ASF ( $p<0.05$ ), selling or slaughtering of pig during the outbreak ( $p<0.05$ ), showed significant association with the outbreak and were considered to be the major risk factors of occurrence as well as spread of ASF. A sero-surveillance study was conducted in the three affected districts of Assam from which a total of 130 representative sera samples were collected and subjected to ELISA test, the overall sero-prevalence of ASF were recorded to be zero per cent. A total of 82 market samples were collected to detect the presence of ASFV from the three affected districts and subjected to PCR test, the overall incidence rate was recorded to be 15.85% (13/82). District wise analysis of presence of ASFV in market samples were recorded to be 29.16% (7/24), 14.63% (6/41) and 0.0% (0/17) in Lakhimpur, Dhemaji and Majuli district respectively. Assessment of total economic loss due to ASF during the outbreak was recorded to be Rs 50,47,830.00 among the study population, concluding ASF as a disease of economic importance. Awareness of the farmers along with adoption of rigorous bio-security measures can break the disease transmission chain and contain the outbreak.

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## **Parvoviral Enteritis in Puppies and Its Therapeutic Management**

*Sayed Nazrin Rumana Rahman*

The present investigation was carried out to study the epidemiology, screening and detection of canine parvovirus infection as well as haematobiochemical alteration, oxidative stress assay and effective therapeutic regimen for canine parvovirus infection in puppies.

A total 134 number of each faecal and blood sample from diarrhoeic dogs were collected from the Department of Veterinary Clinical Complex of College of Veterinary Science, A.A.U., Khanapara and in the greater Guwahati area under Kamrup Metro district of Assam.

Out 134 number of dogs examined with haemorrhagic gastroenteritis, 81 dogs were found positive in rapid antigen test with prevalence of 60.45% while on PCR revealed a prevalence of 80.25%.

Canine Parvovirus infection was most common in >3-6 months old dogs as compared to other age group (11.94%).

The sex- wise prevalence of CPV infection was significantly higher ( $P<0.01$ ) in males (62.65%) as compared to female dogs (56.86%).

Breed-wise distribution of CPV infection revealed highest prevalence of disease in Mongerls (21.64%) and was significantly higher ( $P<0.01$ ) as compared to other dog breeds.

CPV infection was found to be the highest (19.40%) in winter followed by monsoon (15.67%), pre-monsoon (14.18%) and post monsoon (11.19%) seasons.

The prevalence of canine parvovirus infection based on vaccination status out of 81 infected dogs, 26 (19.40%) were vaccinated for Parvovirus infection and 55(41.04%) dogs were not vaccinated. The highest Prevalence of canine parvovirus infection was recorded in the unvaccinated dogs (41.04%). The variation was found to be statistically significant ( $P<0.01$ ).

In the present investigation, the most predominant symptoms of CPV infection were dullness (98.77%), followed by bloody diarrhoea (97.53%), vomition (96.21%),

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Anorexia (90.12%), dehydration (39.51%), Pyrexia (33.33%) and pale mucous membrane (64.11%).

Polymerase Chain Reaction (PCR) was found to be highly sensitive and specific in detecting CPV infection as compared to LFA.

Haematological alterations in CPV infection revealed significant ( $P<0.01$ ) decrease in haemoglobin ( $7.01\pm 0.33$  g/dl), TEC ( $16\pm 0.09\times 10^6/\text{mm}^3$ ), TLC ( $4.03\pm 0.18\times 10^3/\mu\text{l}$ ), PCV ( $29.77\pm 0.48\%$ ), MCV ( $52.32\pm 0.88$  fl), MCH ( $16.45\pm 0.39$  pg), MCHC ( $31.39\pm 0.50$  g/dL), Thrombocyte count ( $102.87\pm 2.49\times 10^6/\mu\text{l}$ ), Neutropenia ( $40.73\pm 1.13\%$ ) and Lymphopenia ( $7.82\pm 0.27\%$ ) but no significant alteration was found in Eosinophil ( $1.84\pm 0.12\%$ ) and monocytic count ( $3.21\pm 0.53\%$ ).

The biochemical profile in CPV infected dogs revealed significant ( $P<0.01$ ) decrease in Albumin ( $2.11\pm 0.02$  g/dL), total protein ( $4.94\pm 0.04$  g/dL), glucose ( $50.54\pm 0.62$  g/dL), sodium ( $140.69\pm 11.96$  mmol/l), potassium ( $2.20\pm 0.10$  mmol/l), and chloride ( $89.75\pm 1.22$  mmol/l), with a significant ( $P<0.01$ ) increase in ALT ( $67.68\pm 1.09$  U/L), AST ( $63.01\pm 1.26$  U/L), BUN ( $65.54\pm 1.04$  mg/dL), ALP ( $262.04\pm 4.18$  U/L), and creatinine ( $1.87\pm 0.03$  mg/dL) values.

Antioxidant enzymes *viz.* Superoxide dismutase (SOD) ( $1.72\pm 0.25$  U/mg Hb) and Catalase ( $13.43\pm 2.53$  mU/mgHb) decreased significantly ( $P<0.01$ ) in CPV infected dogs with significant ( $P<0.01$ ) increase in Lipid peroxidation (LPO) assay ( $6.25\pm 0.66$  nmol /mg Hb)

Significant difference in the haemato-biochemical parameters was recorded in all the treated groups in pre treatment period as compared to healthy control group. The parameters improved significantly in post treatment period *viz.*, on 7<sup>th</sup> and 15<sup>th</sup> day in all the treatment groups.

Among all the treated groups, dogs of group III treated with combined therapy comprising Conventional treatment + hyperimmune serum showed cent percent recovery by the end of Day 15 post treatment as compared to group-II (Conventional+ Egg derived protein) and group-I (Conventional).



# **Evaluation of Immune Response in Broiler Chicks Immunized with a Minimum Cold Chain Dependent Newcastle Disease Virus Formulation**

*Rofique Ahmed*

Among the infectious diseases of poultry, Newcastle disease (ND) is considered one of the most economically fatal viral diseases causing morbidity and mortality of about 90-100% in its velogenic form. Only through vaccination the economic menace and clinical condition caused by NDV can be controlled. But commercially available vaccines against ND are generally thermolabile and lose their potency if kept at room temperature (25°C) for 1-2 hours. The recent COVID-19 pandemic clearly showed the weakness of the vaccine supply chain and its maintenance. The lack of thermostable formulations is one of the major limitations that the COVID-19 pandemic has brought to light. Addressing the need for thermostable vaccine development, the present study was carried out with the study of the thermal stability of a thermostable NDV vaccine formulation (As/Km/19/44) and its immunogenic potential in broiler chicks.

In the present study, after receiving the thermoadapted ND seed virus (As/Km/19/44) confirmation was done by haemagglutination test (HA) and by Reverse Transcription- Polymerase Chain Reaction (RT-PCR) by the amplification of the 363 bp partial *F* gene. After confirmation, a thermal stability test of the seed virus (As/Km/19/44) was done by subjecting the isolate at 40°C and 56°C for 120 minutes respectively. The thermoadapted ND seed virus (As/Km/19/44) retained its HA activity and infectivity at 40°C up to 120 minutes without any decay in virus titre and at 56°C, the thermoadapted ND seed virus (As/Km/19/44) retained its half-life for 83.13 and 96.60 minutes in terms of HA activity and infectivity respectively. Further, lyophilization of the seed virus (As/Km/19/44) was done using chemical excipients viz., Pullulan (10% w/v), Trehalose (0.5M) and Inulin (45mg/ml) to prepare the immunogenic formulation. After formulation, the comparative HA activity and infectivity before and after lyophilization showed no significant difference at  $P < 0.05$ . The lyophilized NDV immunogenic formulations (As/Km/19/44) were grouped and kept at different temperatures viz., 4°C for six months, room temperature (about 25°C) for six months, 37°C for one month, and 56°C for 15 days for evaluating the thermal

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stability. At 4°C, no fall of virus titer in terms of HA activity and infectivity were recorded for up to 6 months. The estimated half-life period of the live NDV immunogenic formulation exposed at room temperature (around 25°C), 37°C and 56°C in terms of HA activity and infectivity was found to be 1008 and 1037; 50.03 and 71.51; 2.194 and 2.764 days respectively.

For evaluation of humoral immune response, the minimum cold-chain dependent NDV formulation (As/Km/19/44) was administered in experimental chicks through an intra-nasal route with a standard dose of 106EID<sub>50</sub> per chick and compared with the commercial LaSota® vaccine. The HI (log<sub>2</sub>) and I-ELISA (log<sub>10</sub>) antibody titers in the serum samples of the experimental chicks at different days post-immunization revealed that there was no significant difference between overall humoral immune response in immunized chicks with minimum cold chain dependent live NDV immunogenic formulation As/Km/19/44 and commercially available LaSota® vaccine strain at P<0.001. Therefore, the minimum cold-chain-dependent NDV immunogenic formulation As/Km/19/44 can be recommended as a suitable live thermostable ND vaccine candidate for prevention and control of ND in areas where cold chain facilities are usually unreliable and can lead to the reduction of vaccine wastage, increase in vaccine efficacy, reduction in cost, ease of application and transportability.

## **Prevalence of Bat Lyssavirus in Assam**

*Tinku Das*

Rabies is one of the oldest known tropical viral zoonotic diseases caused by *Lyssavirus* of the family *Rhabdoviridae*, affecting all warm-blooded mammals. Annually ~ 60,000 people succumb to rabies every year, out of which, India alone bears the burden of 36 per cent of the global cases. Even though most of these cases are canine-mediated, but there is no dearth of data regarding bats being one of the primary reservoirs of the virus. Several species of bat *Lyssavirus* have been documented and bat-transmitted rabies in humans has been regularly reported since the last century. In the present study, 34 bat samples belonging to nine species of bats were collected from eight districts of Assam, namely, Kamrup (M), Baksa, Chirang, Barpeta, Kokrajhar, Golaghat, North Lakhimpur and Dhemaji, and tested for the presence of bat *Lyssavirus* as per the OIE guidelines. The samples were subjected to Lateral Flow Assay (LFA), Direct Fluorescent Antibody Technique (DFA), One-step PCR. None of the samples were positive for lyssavirus indicating absence of an active lyssaviral infection in the bats during the study period.

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**Department: Veterinary Epidemiology and Preventive Medicine**

**Major Adviser: Dr. (Mrs.) Jyoti B. Dutta**

## **Ehrlichiosis In Dogs: Its Epidemiology And Therapeutic Management**

*Queen Devi*

The present study entitled “Ehrlichiosis in dogs: its epidemiology and therapeutic management” was undertaken w.e.f. September 2021 to August 2022 with the objective to study occurrence, clinico-haematobiochemical and ultrasonographic alteration as well as to evolve an effective therapeutic regimen for *Ehrlichia* infection in the dog. The study revealed an overall prevalence of 4.68% on microscopy and a prevalence of 62.00% based on PCR assay. The study revealed the highest breed prevalence in German Shepherd (13.33%), largely affecting the age group of 1-3 years (9.80%) affecting male dogs predominantly (7.62%) with higher prevalence in monsoon season. Microscopic examination as well as nested PCR assay confirmed that *E. canis* is the species responsible for causing the disease. The present study revealed that ticks collected from affected dogs were *Rhipicephalus sanguineus*. The most prominent clinical signs of ehrlichiosis observed were inappetance (100 %) followed by depression (87.09%), tick infestation (80.64%), pale mucous membrane (80.64%), pyrexia (48.23%), diarrhoea (22.58) emesis (22.58%), respiratory distress/nasal discharge (12.90%), lameness (12.90%), haematemesis (12.90), epistaxis (9.68%), corneal opacity/ocular signs (9.68%), melena (9.68%), neurological signs (6.45%), petechial hemorrhages (6.45%), epistaxis (9.68%), icterus (3.22%), ascites/edema/abdominal distention (3.22%). Haematology revealed significantly lower level of haemoglobin, packed cell volume, total erythrocyte count, total leucocyte count and thrombocyte count. Serum biochemistry revealed hypoproteinemia and hypoalbuminemia. The level of glutathione peroxidase in the affected groups was found to be significantly lower than the control group whereas superoxide dismutase was significantly higher than the control group. Ultrasonographic changes observed were hepatomegaly, splenomegaly and kidney with hyperechoic cortex. Imidocarb dipropionate and doxycycline combination was found to be the most effective treatment against ehrlichiosis in dog.

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**Abstract of M.Sc. thesis**

**Department: Veterinary Epidemiology and Preventive Medicine**

**Major Adviser: Dr. Deepa Lahkar**

## **Adoption Level in Scientific Poultry Rearing Practices in Ri-Bhoi District of Meghalaya**

*David Teileng Sun*

The poultry industry in India represents a major success story. It forms a major portion and is one of the fastest growing sectors of agricultural sector in India today. It has shown a tremendous growth and has transformed itself from a backyard venture to a vibrant agribusiness over the last four decades. It plays major role for the rural poor and marginalized section of the people. It is a powerful tool for alleviation of rural poverty, eradication of malnutrition, employment generation, augmenting rural income in eggs, meat and compost. Poultry farming has become an important source of nutrition and livelihood security, especially in developing nations like India and other South East Asian countries.

Therefore, the study was conceptualized with the overall objective to study on “Adoption Level in Scientific Poultry Rearing Practices in Ri-Bhoi District of Meghalaya.” The study was carried out in two purposively selected blocks of Ri-Bhoi district namely Bhoirymbong and Umsning development blocks. A total number of 1362 poultry households were involved in poultry farming from the selected blocks. From each block 50 (fifty) number of respondents were selected which made the total sample size of 100 (one hundred). The respondents were selected through proportionate stratified random sampling from the eight villages i.e., four villages from each block. Data on socio-economic status, adoption level of scientific poultry rearing practices and constraints in adoption of scientific rearing practices in poultry farming were gathered by the researcher through personal interview method.

The study revealed that majority (65.00 per cent) of the respondents average age were 40 years, (81.00 per cent) married, (51.00 per cent) males, (80.00 per cent) nuclear type of families, (63.00 per cent) medium sized family of around 6 members, (74.00 per cent) medium level of education and educated up to the middle to high school level in both the blocks. There was significant difference between the two blocks in age ( $t$  value=2.25\*,  $P<0.01$ ). They had medium level of occupation (58.00 per cent) where animal husbandry cum veterinary was their primary occupation. There was highly significant difference between the two blocks in occupation ( $t$  value =2.86\*\*,  $P<0.01$ ).

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They had medium level of information source (73.00 per cent) which used family members, friends or relatives, neighbours/peer groups, livestock dealers/sellers as their main source of information. There was highly significant difference between the two blocks in information source ('t' value =4.64\*\*, P<0.01), majority (68.00 per cent) had medium level of social participation, (82.00 per cent) extension contact for more than once a year, (86.00 per cent) had duration of time spent which was 3 hours a day in managing poultry birds. There was highly significant difference between the two blocks in social participation ('t' value =2.64\*\*, P<0.01). The farmers had medium level in total annual income from all sources (74.00 per cent), (78.00 per cent) annual income from poultry, (90.00 per cent) livestock and (70.00 per cent) from poultry and livestock. The majority (74.00 per cent) had medium length of experience of average seven years in poultry farming and (64.00 per cent) mass media exposure. The internet was the main source of mass media exposure followed by television, newspaper and radio. Majority (94.00 per cent) of respondents adopted intensive system followed by (6.00 per cent) semi-intensive system. Majority (92.00 per cent) used GI sheets, (6.00 per cent) thatch, (57.00 per cent) mud floor, (40.00 per cent) concrete floor, (2.00 per cent) wooden floor, (40.00 per cent) wire net and concrete wall, (30.00 per cent) other material like GI sheet and (27.00 per cent) bamboo. From the study it was revealed that majority of the respondents in all the dependent variables occupied medium group of frequency distribution in adoption level of scientific or improved practices which include (72.00 per cent) housing, (82.00 per cent) feeding, (92.00 per cent) source of chick, (89.00 per cent) management, (83.00 per cent) health care, (78.00 per cent) bio-security and (85.00 per cent) was the overall adoption level of scientific poultry rearing practices.

The study also found out that the relationship of adoption level by the poultry farmers with their socio-economic status, correlation coefficients were calculated which indicated that in the pooled sample adoption level exhibited highly positive and significant relationship with education ( $r=0.333^{**}$ ,  $P<0.01$ ) and extension contact ( $r=0.258^{**}$ ,  $P<0.01$ ) whereas mass media exposure ( $r=0.224^*$ ,  $P<0.05$ ) and farm size ( $r=0.202^*$ ,  $P<0.05$ ) exhibited positively significant relationship with adoption level. Annual income from other source ( $r = -0.409^{**}$ ,  $P<0.01$ ) showed negatively and highly significant relationship with adoption level. Family size ( $r = -0.218^*$ ,  $P<0.05$ ) exhibited negatively significant relationship with adoption level. The constraints of rearing poultry encountered by the farmers were feed and feeding related constraints - like less availability and high cost of feed as the most important constraint and expensive nature of all inputs day old chicks, feed, equipments, financial problem for maintenance of poultry farm, low or poor market and difficulty in supply chains of inputs especially in Covid-19 pandemic situation, lack of initial capital fund, market exploitation by middlemen were some of the common and important constraints of the respondents.

## **Impact of Female Participation in Livestock and Poultry Enterprises in Ensuring Women Empowerment and Household Food Security Among Selected Tribes/ Ethnic Group in Goalpara District of Assam**

*Deepjyoti Roy*

A study titled “Impact of Female Participation in Livestock and Poultry Enterprises in Ensuring Women Empowerment and Household Food Security among Selected Tribes/ Ethnic Group in Goalpara District of Assam” was conducted with a view to investigate gender participation in livestock enterprises, to find the socio-personal, socio-economic and psychological parameters of the women of four tribes/ ethnic group along with their time spent in livestock related activities, their nature and extent of participation and to assess the impact of their participation in these activities on their overall household empowerment and food security. The Goalpara district of Assam was purposively selected, from where a total of two hundred respondents- fifty each from Rabha, Garo, Hajong and Koch-Rajbongshi communities were surveyed for the study, the selection being done via snowball sampling method.

The study revealed that majority of the respondents belonged to young age category (54.00 per cent), had small sized family (54.00 per cent), lived in a joint family system (56.50 per cent), had small land holding (69.00 per cent), possessed small sized herd (59.50 per cent) and had low level of education (37.00 per cent), social participation (65.50 per cent), mass media exposure (65.00 per cent) and extension contact (55.50 per cent). They also earned low annual income from livestock and poultry rearing (61.50 per cent), from other sources (67.20 per cent) and as well as from all sources (66.00 per cent). In respect of experience in livestock and poultry rearing majority (61.50 per cent) of them had short experience, had favourable attitude towards improved livestock farming (51.00 per cent) and high level of liking for information sources (46.50 per cent). Majority (54.50 per cent) of the respondents considered animal husbandry as a secondary source of income. The highest number (38.00 per cent) of the respondents spent medium time engaged in various livestock rearing activities. Significant difference was observed among the communities in respect of their level of

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education (15.799\*\*,  $P < 0.01$ ), level of social participation (6.029\*\*,  $P < 0.01$ ), level of experience in livestock rearing (4.131\*\*,  $P < 0.01$ ), level of mass media exposure (16.890,  $P < 0.01$ ), level of extension contact (13.496\*\*,  $P < 0.01$ ), herd size (3.021\*,  $P < 0.05$ ), land holding (10.166\*\*,  $P < 0.01$ ), annual income from livestock and poultry rearing (7.197\*\*,  $P < 0.01$ ), annual income from sources other than livestock and poultry rearing (8.962\*\*,  $P < 0.01$ ), total annual income from all sources (9.552\*\*,  $P < 0.01$ ), liking of information sources (17.560\*\*,  $P < 0.01$ ), attitude towards improves livestock farming (19.586\*\*,  $P < 0.01$ ), time spent in livestock activities (7.595\*\*,  $P < 0.01$ ).

Gender-wise it was seen that all the activities involved the participation of both males and females. No such activity was observed where only lone male or lone female participation was present. The chi-square analysis revealed that the activities like 'collection of fodder' (18.361\*), 'milking' (12.989\*), 'selling of milk and milk products' (14.633\*), 'preparation of milk products' (14.010\*), 'collection of dung' (13.448\*), 'preparation of dung cake' (13.448\*) and 'bathing of animals' (19.215\*) revealed significant chi-square values at  $P < 0.05$  level of probability which indicated that gender was significantly associated with tribe/ethnicity in respect of these activities.

In respect of nature of participation, respondents alone participated in higher number in most of the activities in comparison to with husband, with in-laws, with children or together. In respect of extent of participation it was seen that the respondents regularly participated in the activities common to both livestock and poultry rearing.

The percentage of women who perceived high level of women empowerment through their participation in livestock and poultry rearing was 52.00 per cent while majority (71.00 per cent) of the respondents had a high level of perception that their participation in such activities ensured household food security.

Relational analysis was conducted between independent variables and the extent of participation, women empowerment and household food security which revealed that herd size ( $r = 0.292$ \*\*,  $P < 0.01$ ), land size ( $r = 0.208$ \*\*,  $P < 0.01$ ), attitude towards improved livestock farming ( $r = 0.409$ \*\*,  $P < 0.01$ ), time spent in livestock activities ( $r = 0.302$ \*\*,  $P < 0.01$ ) showed highly significant and positive correlation with extent of participation while education ( $r = -0.195$ \*\*,  $P < 0.01$ ) and total annual income from all sources ( $r = -0.200$ \*\*,  $P < 0.01$ ) exhibited highly significant and negative correlation with extent of participation. While mass media exposure ( $r = -0.179$ \*,  $P < 0.05$ ) showed significant and negative correlation with extent of participation. Regression analysis showed that herd size (2.706\*\*,  $P < 0.01$ ), land size (2.635\*\*,  $P < 0.01$ ), attitude towards improved livestock farming (4.953\*\*,  $P < 0.01$ ) and time spent in livestock activities (3.335\*\*,  $P < 0.01$ ) showed a highly significant effect on the extent of participation. The coefficient of determination ( $R^2$ ) was found to be 0.369 which indicated that 36.90 per cent of variation in extent of participation could be explained by these variables. The F value (7.164) was found to be positive and highly significant and indicated that these variables were good predictors of extent of participation.

In respect of women empowerment, it was observed that 7 out of 15 variables viz. age ( $r = 0.249$ \*\*,  $P < 0.01$ ), social participation ( $r = 0.363$ \*\*,  $P < 0.01$ ), experience in



livestock farming ( $r= 0.235^{**}$ ,  $P<0.01$ ), extension contact ( $r= 0.323^{**}$ ,  $P<0.01$ ), annual income from livestock rearing ( $r= 0.335^{**}$ ,  $P<0.01$ ), attitude towards improved livestock farming ( $r= 0.278^{**}$ ,  $P<0.01$ ), time spent in livestock activities ( $r= 0.459^{**}$ ,  $P<0.01$ ) exhibited highly significant and positive correlation with household women empowerment while family size ( $r=-0.211^{**}$ ,  $P<0.01$ ) showed highly significant and negative correlation with household women empowerment. On the other hand, multiple regression analysis showed that age ( $2.680^{**}$ ,  $P<0.01$ ), social participation ( $4.208^{**}$ ,  $P<0.01$ ), herd size ( $-3.950^{**}$ ,  $P<0.01$ ), attitude towards improved livestock farming ( $5.456^{**}$ ,  $P<0.01$ ) and time spent in livestock activities ( $4.227^{**}$ ,  $P<0.01$ ) showed a highly significant contributing effect on household women empowerment and liking of information sources ( $-2.274^{*}$ ,  $P<0.05$ ) showed a significant contributing effect on women empowerment. The coefficient of determination ( $R^2$ ) was found to be 0.466 which indicated that 46.60 per cent of variation in household women empowerment could be explained by these variables. The F value (9.968) was found to be positive and highly significant and indicated that these variables were good predictors of household women empowerment.

While in case of household food security, out of 15 independent variables social participation ( $r= 0.242^{**}$ ,  $P<0.01$ ), mass media exposure ( $r= 0.216^{**}$ ,  $P<0.01$ ), annual income from livestock farming ( $r= 0.276^{**}$ ,  $P<0.01$ ), attitude towards improved livestock rearing ( $r= 0.343^{**}$ ,  $P<0.01$ ), liking of information sources ( $r= 0.204^{**}$ ,  $P<0.01$ ), time spent in livestock activities ( $r= 0.228^{**}$ ,  $P<0.01$ ) exhibited highly significant and positive correlation with household food security while extension contact ( $r= 0.162^{*}$ ,  $P<0.05$ ) showed significant and positive relationship with household food security. The regression analysis further revealed that social participation ( $3.680^{**}$ ,  $P<0.01$ ), mass media exposure ( $2.678^{**}$ ,  $P<0.01$ ), attitude towards improved livestock farming ( $5.262^{**}$ ,  $P<0.01$ ) showed highly significant effect on household food security while herd size ( $-2.065^{*}$ ,  $P<0.05$ ) had significant effect on the same. The coefficient of determination ( $R^2$ ) was found to be 0.334 which indicated that 33.40 per cent of variation in food security could be explained by these variables. The F value (6.144) was found to be positive and highly significant and indicated that these variables were good predictors of the household food security.

Further correlation co-efficient was calculated of extent of participation with that of women empowerment and household food security. No significant relation between the extent of participation of the respondents in livestock and poultry enterprises with the level of household empowerment of women or household food security was present.

# **Participation of Tribal Farmwomen in Livestock Management Activities in Dima Hasao District of Assam**

*Komolika Bodo*

There are diverse ways in which livestock contributes to the household food and nutrition and rural women in India plays a crucial role in managing livestock. India has a long history of involving women in raising of livestock because domestic animals have long been an essential component of the family farming system. Studies on varied tasks shouldered by the rural women in livestock management are of utmost relevance in highlighting their contributions at the family level. For the planners, decision-makers and extension workers such studies serve as the baseline for initiating projects for rural development. With this reality in mind, the current study on the "Participation of Tribal Farm Women in Livestock Management Activities in Dima Hasao District of Assam" carried out. The study was conducted in two selected blocks of the Dima Hasao district i.e., Diyungbra ITDP Block and Jatinga Valley Development Block which were purposively selected in keeping adherence with the objectives to explore a) The socio-economic profile of the respondents in the study area, b) The extent of involvement of womenfolk in livestock management activities in the study area, c) The extent of participation of women in decision making process in livestock management activities, and d) The relationship between extent of involvement and decision making of womenfolk in livestock management activities. As such, 60 respondents or tribal women from each block i.e., Diyungbra ITDP Block and Jatinga Valley Development Block were selected snow ball sampling making the total sample size 120. A pretested, reliable, and valid interview schedule was used for data collection. The data collected were analyzed using IBM SPSS Statistics version 24. Majority of the tribal women livestock farmers i.e. 68.33 per cent were in middle age category and the average age was found to be 41.35 years. 96.67 per cent of respondents were married while only 2.50 percent were widows and 0.83 per cent were unmarried. It was observed that 81.67 per cent farm women resided as nuclear family while 18.33 per cent as a joint family. Majority of respondents in Diyungbra ITDP Block i.e. 81.67 per cent and Jatinga Valley

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Development Block 76.67 per cent had medium family size with 3-6 numbers. Majority (35.00 per cent) of the respondents were engaged in Agriculture + Animal husbandry + Weaving in Diyungbra ITDP Block and 33.33 per cent were engaged in Agriculture + Animal husbandry + Government employed in Jatinga Valley Development Block. It was found that most respondents in Diyungbra ITDP Block and Jatinga Valley Development Block i.e., 63.33 per cent and 50.00 per cent had medium educational qualification. The majority of respondents in both the blocks i.e. 81.67 per cent and 83.33 per cent had medium-sized herd. The majority of respondents in both the blocks i.e. 75.00 per cent and 73.33 per cent had a medium level of social participation. Most respondents in Diyungbra ITDP Block and Jatinga Valley Development Block showed low level of extension contact, i.e., 46.67 per cent and 48.33 per cent respectively. Majority of the respondents in Diyungbra ITDP Block, i.e., 93.33 per cent and 90.00 per cent in Jatinga Valley Development Block did not receive any training on livestock management. Mass media exposure in both the blocks was of medium level with 45.00 per cent respondents in Diyungbra ITDP Block and 70.00 per cent in Jatinga Valley Development Block. It was observed that in Diyungbra ITDP Block and Jatinga Valley Development Block most respondents i.e., 48.33 per cent and 58.33 per cent had low farm land holding. The majority of respondents in Diyungbra ITDP Block and Jatinga Valley Development Block i.e., 63.33 per cent and 71.67 per cent had medium total land holding. It was reflected in the study that most respondents in Diyungbra ITDP Block and Jatinga Valley Development Block had medium level of income from livestock with an average of Rs. 25983.33/year. Total annual income of respondents in Diyungbra ITDP Block and Jatinga Valley Development Block was of medium level with an average of Rs. 151166.67. Majority of the respondents i.e., 41.67 per cent faced a medium level of distance to reach the market. Most respondents i.e., 76.67 per cent had a medium level of involvement in livestock management activities with a mean of 13.72 in the sub-area of feeding and watering, 12.17 in breeding, 12.15 in general management and 11.59 in animal health care. Most respondents i.e., 71.67 per cent had a medium level of decision-making in livestock management activities with a mean of 14.48 in household activities followed by a mean of 12.42 in feeding and watering of animals, 10.75 in general management, 7.01 in animal health care, and 6.77 in breeding. In correlational analysis 3 independent variables viz. age had a positive and highly significant correlation and mass media exposure had a negative and highly significant correlation with the extent of involvement of womenfolk in livestock management activities in Diyungbra ITDP Block. In Jatinga Valley Development Block also age had a positive and highly significant correlation and mass media exposure had a negative and highly significant correlation with the extent of involvement of womenfolk in livestock management activities. In Diyungbra ITDP Block, 3 independent variables viz. age, herd size and extension contact, showed a positive and significant correlation but mass media exposure had a negative and significant correlation with the extent of participation of women in decision making process of women in livestock management. In Jatinga Valley Development Block, age had a positive and highly significant

correlation, extension contact had positive and significant correlation, mass media exposure had a negative and highly significant correlation and farm landholding showed a negative and significant correlation with the extent of participation of women in decisionmaking process of women in livestock management. Regression analysis between independent variables and the extent of involvement of womenfolk in livestock management activities could not attain a level of significance. The co-efficient of multiple determination (R<sup>2</sup>) value was found to be 0.269, and the F value for R was found to be non-significant. regression analysis between independent variables and the extent of decision-making process of women in livestock management showed that the age of respondents of Dima Hasao District had a positive and significant relation ( $p < 0.05$ ). Herd size also had a positive and significant relation ( $p < 0.05$ ). The co-efficient of multiple determination (R<sup>2</sup>) value was found to be 0.273, and the F value for R was found to be non-significant.

# **Dynamics of Urbanization in the Livelihood of Livestock Farmers in the Peri-Urban Areas of Guwahati City**

*Parag Sankar Choudhury*

Since urbanization is described under specific conditions and time period so going by the changes in the livelihood of livestock farmers in the Deepor Beel areas a study entitled “Dynamics of Urbanization in the Livelihood of Livestock Farmers in the Peri-Urban Areas of Guwahati city” is taken up which will give an insight into the livelihood status of the villagers in a holistic way. The study was conducted in the peri-urban areas in and around Deepor Beel in five revenue villages which was purposively selected namely Pamehi, Mikirpara, Chakardoe, Lakhara and Azara with four objectives-1) To study the socio- economic status of the livestock farmers in the fringe areas of Deepor Beel. 2) To explore the implications of rural-urban linkages in the livelihood of livestock farmers in the study area. 3) To find out the factors that influences the intensity of market participation of the farmers in Deepor Beel. 4) To study the relationship of rural urban linkages and intensity of market participation on socio-economic status of the farmers. Livestock farmers having two or more species of animals including poultry birds in their backyard were taken into account as respondents in the study. 20 livestock farmers from 5 revenue villages were taken into account to make a total sample size of 100. The data was collected personally by visiting the selected respondents through the use of a pretested, reliable and valid interview schedule. Data so collected was compiled, analyzed, tabulated and interpreted using appropriate statistical methods and software. Majority of the respondents (68.00 per cent) belonged to middle age group and average age was found to be around 43.82 years. Again majority, i.e., 71.00 per cent of the respondents were male. Further, majority of the farmers (87.00 per cent) were married and again majority (78.00 per cent) resided as nuclear family. It was observed that 82.00 per cent of livestock farmers had medium sized family with 5-6 members and majority of them (39.00 per cent) belonged to Scheduled Tribe category. Moreover, 76.00 per cent of respondents had education up to high school level and it was found from the study that 73.00 per cent of the respondents had medium herd size ranging from 1.91 to 14.58 cattle equivalent

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units. Again, majority (67.00 per cent) of respondents had medium level of experience in livestock farming ranging from 13.26 years to 34.54 years. However, in case of land holdings, majority of them (68.00 per cent) had low land holding i.e., <0.76 acres. It was indicated that majority (59.00 per cent) of respondents revealed medium distance from home to market (2.62 kms to 6.61 kms) and 99.00 per cent of the respondents reported good transportation/access to market. Again, majority (64.00 per cent) of livestock farmers was found to have medium exposure to mass media and majority of them (48.00 per cent) had medium extension contact. Moreover, Majority (69.00 per cent) of livestock farmers had medium annual family income from livestock and poultry (Rs. 14339.84 to Rs. 33142.16). Majority (66.00 per cent) of the livestock farmers belonged to medium income category on including annual income from all sources (Rs. 17118.00 to Rs. 287942.00). On assessing four sub-areas of implications namely social implications, implications on asset-base, implications on information flow and implications of house hold economy it was indicated that implications on asset-based is highest followed by household economy on livelihood of livestock farmers. A sum of total implications on mean, S.D. and range was found to be 46.82, 4.57 and 32-54 respectively. On distribution of respondents on the basis of implications of rural-urban linkages in the livelihood of livestock farmers it was further observed that majority of respondents (71.00 per cent) were in medium category. Furthermore, on distribution of respondents on basis of Intensity of Market Participation of Livestock Farmers on basis of 13 indicator statements it was found that majority of livestock farmers (66.00 per cent) were in medium category. In co-relational analysis age with respect to implications had a positive and significant correlation ( $r= 0.223^*$ ) among the livelihood of livestock farmers in rural-urban linkage. However, years of experience on livestock farming of the livestock farmers to implications was negatively and significantly correlated ( $r= -0.197^*$ ). Mass media exposure was found to be positively and significantly correlated in the statistical level of significance ( $r= 0.213^*$ ) with intensity of market participation. Last but not the least, income from all sources was found to be positively and significantly correlated in the statistical level of significance ( $r= 0.196^*$ ) with intensity of market participation.

# **Women Empowerment Through Self-Help Group With Special Reference to Animal Husbandry: ASRLM Perspective**

*Rahul Kanti Deka*

In recent years the group approach to poverty alleviation is getting recognition in Asian countries. Mostly, women are mobilized in to groups for undertaking mutually beneficial social and economic activities. The group provides the women a base for self-employment and empowerment through group dynamics. In India these mutual help based groups are known as Self Help Group (SHG). In 1999, GOI introduced Swarn Jayanti Gram Swarajgar Yojana, a programme aimed at bringing families above the poverty line by ensuring sustainable level of income over a period of time which later in 2011 renamed as NRLM and in 2016 again renamed as DAY-NRLM. NRLM is being implemented in Assam by Assam State Rural Livelihoods Mission Society (ASRLMS) with the objectives laid by NRLM for enhancing the social and economic empowerment of the rural poor of Assam

Although several researches have been conducted on SHGs in general, negligible research has carried out in Animal husbandry in particular. So, the present study entitled “Women empowerment through self - help group with Special Reference To Animal Husbandry is proposed with the objectives a) to study the socio-personnel and economic profile of women SHG members, b) to appraise the organizational dynamics and financial management of SHG, c) to study different dimensions of empowerment of women SHG members, and d) to delineate the constraints as perceived by the respondents in rearing and marketing of livestock and poultry. Four block namely Rangia and Kamalpur from Kamrup (R) and Pub Nalbari and Paschim Nalbari from Nalbari district have selected. As such, 25 respondents or women SHG members from each block were selected randomly making the total sample size 100. A pretested, reliable, and valid interview schedule was used for data collection. The data collected were analyzed using standard statistical methods. Majority of the respondents i.e. 64.00 per cent were in middle age category and the average age was found to be 47.00 years. 87 per cent of respondents were married while only 5.00 percent were widows and 8.00

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per cent were unmarried. It was observed that 75.00 per cent farm women resided as nuclear family while 25.00 per cent as a joint family. 81.00 per cent of the respondents having medium family size with average size of 6. It was found that most respondents i.e. 78.00 per cent had medium educational qualification. Majority of the respondents 53.00 per cent were doing agriculture and animal husbandry as the major occupation. Majority of the respondents having medium level of experience in animal husbandry. Majority of the respondents i.e. 55.00 per cent are doing goatery, dairy and poultry as their livestock occupation. 100 per cent of the respondents took loan from bank, village organization and cluster level federation. 47.00 per cent of the respondent's medium level of social participation. 100 per cent of the respondents attended either formal or consultancy based training. 62.00 per cent of the respondents having medium level of mass media exposure. 67.00 per cent of the respondents having medium level of extension agency contact. Majority i.e. 89.00 per cent of the respondents adopted middle man as the marketing channel. It was observed majority of the respondents having medium level of land holding. It was reflected in the study that most respondents in all four blocks, respondents had medium level of income from livestock with an average of Rs. 118819/year. Total annual income of respondents in selected block was of medium level with an average of Rs. 226667. Among 9 variables age shown negative correlation with women empowerment where as other 8 variables have shown positive correlation. In case of correlation with constraints, among 9 variables, age shown positive correlation whereas other 8 variables shown negative correlation. Significant relation in regression analysis between independent variables and women empowerment is shown by age ( $p < 0.05$ ) and educational qualification ( $p < 0.05$ ). In constraints with independent variables experience in animal husbandry showed a negative and significant relation ( $p < 0.05$ ). The co-efficient of multiple determination ( $R^2$ ) value was found to be 0.426, and the F value for R was found to be non-significant.



## **Performance of Assam Hill Goat Reared Under Bamboo and Wooden House**

*Armina Sultana Begum*

The experiment was carried out at Goat Research Station, Assam Agricultural University, Byrnihat, Guwahati, Assam under the supervision of the Department of Livestock Production and Management, College of Veterinary Science, Khanapara, Guwahati-781022 for a period of three months from February to May, 2022 to study the performance of Assam Hill goat reared under different house.

Twelve (6 male and 6 female) healthy Assam Hill goats; approximately two to three months old were randomly divided into two groups ( Group I and Group II) consisting six animals in each group. During the experimental period, the kids were sheltered in group in an elevated (4 ft.) two different types of house *i.e.* elevated bamboo and wooden house of the Goat Research Station, Assam Agricultural University, Byrnihat. All experimental kids were managed intensively under the same feeding managemental care. The feed were offered as 1/3rd concentrate ration on DM basis with 2/3rd roughages in both the groups.

The average initial and final body weight of kids in bamboo and wooden house were  $5.92 \pm 0.15$  and  $9.62 \pm 0.13$  kg and  $5.85 \pm 0.22$  and  $8.55 \pm 0.17$  kg respectively. The overall body weight of kids was found to be  $7.69 \pm 0.20$  and  $7.20 \pm 0.15$  kg respectively. The fortnightly body weight have no significant difference in 1st, 2nd and 3rd fortnight, however in 4th fortnight it was found to be significant difference ( $P < 0.05$ ) between the groups. The body weight in 5th and 6th fortnight was recorded highly significant ( $P < 0.01$ ); on the other hand in overall, it showed insignificant difference between the groups.

The overall fortnightly body weight gain were found to be  $0.617 \pm 0.02$  and  $0.450 \pm 0.01$  kg in group I and group II respectively. The overall daily body weight gain was recorded as  $41.11 \pm 1.17$  and  $30.00 \pm 0.91$  g. The total body weight gain from 1st to 6th fortnight period were  $3.7 \pm 0.04$  and  $2.7 \pm 0.12$  kg in respective group. The body weight gain in every fortnight and daily body weight gain showed insignificant difference in 1st fortnight while in 2nd and 3rd fortnight had significant ( $P < 0.05$ ) differences and in 4th, 5th, 6th and overall were highly significant ( $P < 0.01$ ) among the

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groups. The total body weight gain was found to be highly significant ( $P < 0.01$ ).

The overall average feed intake in Group I and Group II were  $1.84 \pm 0.026$  and  $1.71 \pm 0.018$  kg, respectively. Feed intake was found to be highly significant difference ( $P < 0.01$ ) at every fortnight and overall among the Group I and II.

The overall average feed conversion efficiency in group I and group II were  $7.01 \pm 0.20$  and  $9.12 \pm 0.31$  respectively. There was no significant differences in feed conversion efficiency at 1st, 2nd and 3rd fortnight among the group I and group II while in 4th and 5th fortnight showed the significant ( $P < 0.05$ ) difference. There was highly significant ( $P < 0.01$ ) difference recorded in 6th fortnight and overall in feed conversion efficiency between the groups.

On calculation of production economy, the cost of production per kid was Rs 433.83 and 396.00 in Group I and II, respectively. The cost of feeding per kg of live weight gain recorded as Rs. 117.25 and 146.67, in the respective groups.

# **Effect of Floor Types on the Milk Quality and Health Status of Crossbred Cows Under Field Condition**

*Arup Deka*

The present study was carried out to assess the effect of floor type on the milk quality and health status of crossbred cows under field conditions. A total of 15 dairy sheds, consisting of 5 concrete, 5 brick and 5 wooden floors were identified, where there were similarities in management and feeding practices. A total of 90 cows (six from each type of shed) were selected for studying the milk quality, milk yield and other milk performance traits. The cows were selected keeping uniformity of their parity and utilized for the trial after the colostrum period was over. In addition to the above, records of 120 numbers of crossbred cows reared under similar management practices were observed for foot & leg disorders, the occurrence of mastitis, skin lesions, respiratory and alimentary tract disorders.

The overall daily milk yield (DMY) in G1 (concrete floor), G2 (brick floor) and G3 (wooden floor) was found as  $10.40 \pm 0.08$ ,  $10.15 \pm 0.07$  and  $9.56 \pm 0.07$  kg, respectively. The significantly ( $p < 0.01$ ) highest daily milk yield was recorded on the concrete floor, while the wooden floor experienced comparatively lower production. The overall mean peak milk yield (PMY) was  $12.37 \pm 0.24$ ,  $11.87 \pm 0.23$  and  $11.40 \pm 0.16$  kg in G1 (concrete floor), G2 (brick floor) and G3 (wooden floor), respectively. Significantly ( $p < 0.01$ ) highest peak milk yield was found in G1 (concrete floor) and the lowest was found in G3 (wooden floor). The overall mean of DAPMY in G1, G2 and G3 was  $44.87 \pm 0.90$ ,  $46.17 \pm 0.89$  and  $47.10 \pm 0.93$  days, respectively. There was no significant difference among the groups, but the concrete floor had comparatively lower DAPMY than that of the other groups. The service periods recorded in the various groups were  $121.10 \pm 5.53$ ,  $126.07 \pm 5.45$  and  $135.20 \pm 5.79$  days in G1 (concrete floor), G2 (brick floor) and G3 (wooden floor), respectively. The service period (SP) had a non-significant difference amongst the groups. SP was found comparatively shorter in G1 *i.e.* concrete floor than that of the other two groups. The average fat content of crossbred cow milk was  $4.29 \pm 0.07$ ,  $4.38 \pm 0.07$  and  $4.26 \pm 0.08$  percent in G1 (concrete floor), G2 (brick-bedded floor) and G3 (wooden floor) groups, respectively. The

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average SNF content was found to be  $9.16 \pm 0.04$ ,  $9.11 \pm 0.03$  and  $9.13 \pm 0.04$  in G1 (concrete floor), G2 (brick floor) and G3 (wooden floor) groups, respectively. The average protein content in different groups was observed to be  $3.50 \pm 0.01$ ,  $3.47 \pm 0.01$  and  $3.49 \pm 0.01$  percent in G1 (concrete floor), G2 (brick-floor) and G3 (wooden floor) groups, respectively. The average lactose was found as  $5.21 \pm 0.03$ ,  $5.18 \pm 0.02$  and  $5.15 \pm 0.03$  percent in different groups viz. G1 (concrete floor), G2 (brick floor) and G3 (wooden floor) groups, respectively. The overall ash content in different groups was noted to be  $0.77 \pm 0.01$ ,  $0.76 \pm 0.01$  and  $0.76 \pm 0.01$  percent in G1, G2 and G3 groups, respectively. The milk composition did not differ significantly amongst the groups. The overall specific gravity for various groups was found as  $1.0336 \pm 0.0002$ ,  $1.0332 \pm 0.0001$  and  $1.0331 \pm 0.0002$  in G1, G2 and G3 groups, respectively. Specific gravity was also recorded as non-significant among the various groups. The total viable count (TVC) in milk for different groups was found to be  $3.99 \pm 0.04$ ,  $4.24 \pm 0.05$  and  $4.37 \pm 0.07$  log cfu/ml in G1 (concrete floor), G2 (brick floor) and G3 (wooden floor) groups, respectively. The overall mean TVC was significantly ( $p < 0.01$ ) highest in milk of cows reared on the wooden floor (G3) and lowest on the concrete floor (G1). The mean TVC was significantly ( $p < 0.01$ ) highest in the 10<sup>th</sup> fortnight in all the groups. The frequency of cows affected with leg and foot disorders was observed to be 57.33, 62.86 and 41.54 percent in G1 (concrete floor), G2 (brick floor) and G3 (wooden floor) groups, respectively. Significantly ( $p < 0.05$ ) highest incidence of leg and foot disorders was observed on brick floors, followed by concrete and the lowest incidence was seen on wooden floors. The incidence of carpal hygroma was witnessed to be 18.67, 21.43 and 12.31 percent in G1, G2 and G3 groups, respectively. No significant difference ( $p > 0.05$ ) was observed between the groups for carpal hygroma. The incidence of hock swelling was 21.33, 24.29 and 10.77 percent in G1, G2 and G3 groups, respectively. Hock swelling did not differ significantly ( $p > 0.05$ ) due to floor type. The incidence of hoof elongation was 9.33, 41.43 and 36.92 percent in G1, G2 and G3 groups, respectively. There was a highly significant ( $p < 0.01$ ) effect of the floor on the occurrence of hoof elongation. Incidence of sole ulcers and others was 9.33, 21.43 and 18.46 percent in G1, G2 and G3 groups, respectively. There was no significant difference ( $p > 0.05$ ) among the groups for sole ulcer and others. The overall incidence of skin lesions was observed to be 68.00, 74.29 and 30.77 percent in G1 (concrete floor), G2 (brick floor) and G3 (wooden floor) groups, respectively. Significantly ( $p < 0.01$ ) highest incidence was observed in the brick floor, followed by the concrete floor and the lowest was seen on the wooden floor. The incidence of clinical mastitis was found to be 6.67, 10.00 and 21.54 percent in G1 (concrete floor), in G2 (brick floor) and in G3 (wooden floor) group, respectively. Significantly highest ( $p < 0.05$ ) incidence of clinical mastitis was recorded on wooden floors, followed by brick floors and the lowest on concrete floors. The incidence of respiratory disorders in different groups was found to be 10.67, 15.71 and 21.54 percent in G1 (concrete floor), G2 (brick floor) and G3 (wooden floor) groups, respectively. There was no significant ( $p > 0.05$ ) difference amongst the groups for the incidence of respiratory disorders. But the incidence was comparatively higher on the wooden floor.

The overall alimentary tract disorders were observed to be 14.67, 18.57 and 26.15 percent in G1 (concrete floor), G2 (brick floor) and G3 (wooden floor) groups, respectively. No significant ( $p > 0.05$ ) difference was observed for alimentary tract disorders among the groups. But the brick and wooden floors had comparatively higher incidences than the concrete floor.

The present study witnessed that the concrete floor shed was better for improving milk quality and yield of crossbred cows, except for the few incidences of foot & leg disorders and skin lesions, which are to be prevented by appropriate management tools.

## **Effect of Dietary Supplementation of Yeast (*Saccharomyces cerevisiae*) on Growth Performance of Crossbred Heifers**

*Chandrika Hazarika*

The aim of the experiment was to investigate the effect of dietary supplementation of yeast (*Saccharomyces cerevisiae*) on growth performance of crossbred heifers. Eighteen crossbred heifers of above 1 year of age (16-18 months) of similar body weight were selected and were divided equally into three groups namely Control (T0), Treatment 1 (T1) and Treatment 2 (T2), each group consisting of six animals. All the heifers in the experimental group were fed with a basal diet of concentrate, para grass and paddy straw, along with a supplementation of 1.5gm/animal/day of dry yeast powder in T1 and 3gm/animal/day of dry yeast powder in T2 group respectively. The experiment was conducted for a period of 3 months (90 days) from 1st January to 31st March, 2022.

The average initial and final body weight at the 6th fortnight of the heifers were 188.18 ±1.07, 188.32 ±0.89 and 188.61 ±0.79 and 216.41 ±1.18, 218.55 ±1.19 and 220.65 ±1.33 kg in T0, T1 and T2 groups respectively. The results of the analysis of variance of data did not reveal any significant difference ( $P>0.05$ ) of average body weight in control and different treatment groups.

The overall mean daily gain of body weight found in T0, T1 and T2 groups were 0.31 ±0.03, 0.35 ±0.06 and 0.36 ±0.07 kg respectively. A significant difference ( $P<0.05$ ) of overall ADG was observed in T1 and T2 compared to T0. The one way ANOVA revealed that the body weight in heifers increased significantly from 4th to 6th fortnight. Similarly, a significant increase ( $P<0.05$ ) in overall fortnightly gain in body weight was observed in T2 (5.31 ±0.10) and T1 (4.94 ±0.12) kg on comparison to T0 (4.56 ±0.04) kg.

The overall mean values of the body conformation traits (cm) in T0, T1 and T2 groups, respectively were found to be as: 116.60 ±0.27, 116.76 ±0.29 and 117.66 ±0.24 cm in body length, 136.96 ±0.12, 137.29 ±0.99 and 137.69 ±0.13 cm for heart girth, and 112.04 ±0.22, 112.51 ±0.20 and 113.17 ±0.21 cm for height at wither. The

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conformation traits revealed a highly positive correlation with body weight. A linear increase in body measurements were observed in all the three experimental groups from 1st to 6th fortnight, along with the body weight. Analysis of data showed no significant ( $P>0.05$ ) difference in the three traits between T0, T1 and T2 groups, respectively.

The overall mean daily feed intake was found to be  $4.66 \pm 0.03$ ,  $4.68 \pm 0.03$  and  $4.72 \pm 0.02$  kg/day in T0, T1 and T2 groups, respectively. Supplementing the diets of the treatment groups with *S. cerevisiae* (1.5gm/head/day and 3gm/head/day in T1 and T2 respectively) showed a higher increase in feed intake compared to T0. However, no significant ( $P>0.05$ ) difference was observed in the average values of daily feed intake amongst T0, T1 and T2 groups.

The average FCE values were  $12.04 \pm 0.21$ ,  $12.22 \pm 0.30$  and  $11.58 \pm 0.35$  in the 1st fortnight and  $12.03 \pm 0.32$ ,  $10.93 \pm 0.25$  and  $10.28 \pm 0.23$  in the 6th fortnight. Overall mean FCE values in were  $12.18 \pm 0.08$ ,  $11.45 \pm 0.22$  and  $10.93 \pm 0.19$  in T0, T1 and T2 respectively. Results of analysis of variance revealed highly significant ( $P<0.01$ ) effect of supplementation of *S.cerevisiae* on feed conversion efficiency of the experimental animals. A post hoc test revealed that the FCE in T2 and T1 group was significantly higher from 3rd to 4th fortnight compared to T0 group.

All the blood parameters estimated under the haemato-biochemical parameters were found within the normal physiological range in the experimental heifers. The overall mean of RBC of heifers were calculated as  $6.44 \pm 0.11$ ,  $6.48 \pm 0.05$  and  $6.51 \pm 0.07$  m/mm<sup>3</sup> in T0, T1 and T2 groups respectively. The overall mean of TLC count in different groups during the entire experiment were  $7.26 \pm 0.09$ ,  $7.28 \pm 0.09$  and  $7.29 \pm 0.09$  m/mm<sup>3</sup> in T0, T1 and T2 groups respectively. The overall mean of PCV% in different groups during the entire experiment were  $26.74 \pm 0.15$ ,  $26.75 \pm 0.16$  and  $26.79 \pm 0.17$  in T0, T1 and T2 groups respectively. The overall mean of glucose (mg/dl) in different groups during the entire experiment were  $54.76 \pm 0.53$ ,  $54.92 \pm 0.65$  and  $55.31 \pm 0.63$  mg/dl in T0, T1 and T2 groups respectively. The overall mean of total protein were  $6.74 \pm 0.07$ ,  $6.75 \pm 0.40$  and  $6.78 \pm 0.07$  (g/dl) in the entire experiment in T0, T1 and T2 groups respectively. Results of the analysis showed no significant ( $P>0.05$ ) difference in the initial and final estimates of blood parameters in T0, T1 and T2 groups respectively.

The analysis of economics of feeding the experimental heifers revealed that the average daily cost of feed consumption per heifer were Rs.71.11, Rs. 72.38 and Rs. 74.27, average net cost of feed consumption per heifer were Rs. 6400.04, Rs. 6514.81 and Rs.6684.87, and the cost of feeding per kg body weight gain were Rs. 226.71, Rs.215.50 and Rs.208.64 in T0, T1 and T2 groups respectively. The higher total body weight gain in T1 and T2 than T0 resulted in lower cost of feeding per kg weight gain in the treatment groups than in the control group. On further calculation, a benefit over control (T0) of Rs.11.21 and Rs.17.82 in T1 and T2 were found.

## **Productive Performance of Sahiwal Cows Subjected to Different Levels of Herbal Supplements**

*Manmi Kalita*

A study was conducted to investigate the effect of different levels of herbal supplements on productive performance of Sahiwal cows. Fifteen healthy Sahiwal cows of similar age and body weight were allocated to three experimental groups namely T0, T1 and T2 with five animals in each group. T0 was fed with balance ration (concentrate mixture, para grass and paddy straw) as per requirement, T1 group was supplemented with 25 gms of fenugreek seed (*Trigonella foenum graecum*) along with balance ration and T2 was fed with 50gms of fenugreek seeds along with balance ration. It was observed that overall mean daily dry matter intake (kg/day) in T0, T1 and T2 were  $10.01 \pm 0.02$ ,  $10.24 \pm 0.03$  and  $10.22 \pm 0.08$  respectively. Analysis of data on dry matter intake showed no significant difference ( $p > 0.05$ ) between control and treatment groups respectively. Furthermore, non-significant differences was found in DMI/100kg body weight between the control and treatment groups. The average digestibility coefficient (%) of DM in T0, T1 and T2 groups was:  $71.12 \pm 0.27$ ,  $73.58 \pm 0.26$  and  $74.72 \pm 0.22$ ;  $72.97 \pm 0.08$ ,  $73.78 \pm 0.06$  and  $75.34 \pm 0.09$  for organic matter (OM);  $67.89 \pm 0.11$ ,  $65.54 \pm 0.05$  and  $68.48 \pm 0.07$  for crude protein (CP);  $70.70 \pm 0.05$ ,  $70.98 \pm 0.09$  and  $72.06 \pm 0.08$  for ether extract (EE);  $48.80 \pm 0.37$ ,  $50.04 \pm 0.29$  and  $56.24 \pm 0.28$  for crude fibre (CF) and  $77.14 \pm 0.15$ ,  $77.35 \pm 0.04$  and  $78.13 \pm 0.09$  for nitrogen free extract (NFE) respectively. Analysis of the data revealed significantly ( $P < 0.01$ ) higher digestibility of the nutrients in herbal supplement (fenugreek seeds) fed treatment groups than control group. The overall mean for milk yield (kg) in the experimental cows were  $7.00 \pm 0.05$ ,  $7.56 \pm 0.08$  and  $7.99 \pm 0.10$  respectively in T0 (control), T1 and T2 groups. Feeding of fenugreek found to have positive effect in the treatment groups. Highly significant differences in milk yield was found ( $p < 0.01$ ) between treatment groups. Also, Milk efficiency was significantly higher ( $p < 0.01$ ) in treatment groups compared to control. However, there was no significant effect of fenugreek seeds in the duration of peak milk and lactational milk yield of the experimental cows. Milk composition like total fat (%),

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solid-not-fat(%), lactose(%), protein(%), ash(%), specific gravity was within the normal range. However highly significant difference ( $p < 0.01$ ) was observed in fat, SNF, lactose, protein and ash content. The blood constituents like blood glucose and total serum protein were within the normal value among the treatment groups and showed no significant differences ( $p > 0.05$ ) between the treatment groups.

Daily cost of feeding per cow per day were Rs. 182.20, Rs. 192.20 and Rs. 195 in T0(control), T1 and T2 respectively. Cost of feeding per kg milk yield was Rs. 26.02, Rs. 25.15 and Rs. 24.40 in T0, T1 and T2 respectively. The benefit cost ratio was found to be higher in treatment groups than in control group. Based on the results of the present study it could be concluded that feeding of fenugreek seed at the level of 50gms daily along with the normal diet increased performance in terms of milk yield, milk composition and digestibility of nutrients. However, there was no significant effect in duration of peak milk yield, lactational milk yield and blood constituents.

## **Performance of Hampshire Piglets Reared on Hot Water Treated Floor**

*Phanidhar Mili*

A study was carried out to see the performance of Hampshire piglets reared on hot water treated floor. A total number of 36 newborn Hampshire piglets were selected from six different litters. The piglets were then grouped into 2 each of 18 piglets *viz.*, floor without any treatment (Group I) and hot water treated floor (Group II) and maintained in conventional system of housing and both the groups were randomly allotted to different treatment floor. The final body weight at 8<sup>th</sup> week for the Group I and Group II piglets were  $7.73 \pm 0.20$  kg and  $7.91 \pm 0.15$  kg respectively and the value being non-significant ( $P < 0.05$ ) in both the group but apparently higher body weight in Group II.

The total body weights gain for group I and group II piglets figured as  $6.47 \pm 0.02$  kg and  $6.64 \pm 0.02$  kg respectively. The average daily gain (ADG) for group I and group II piglets appeared as  $0.116 \pm 0.0004$  and  $0.119 \pm 0.0004$  kg respectively. The total and daily body weight gains appeared to be non-significant ( $P < 0.05$ ). This revealed that hot water treated floor had a positive effect on the body weight gains of the piglets.

The total feed intake per piglet during the whole experimental period was  $9.289 \pm 0.401$  kg and  $9.363 \pm 0.403$  kg for Group I and Group II respectively. The weekly average feed intake in Group I and Group II was  $1.548 \pm 0.401$  kg and  $1.561 \pm 0.403$  kg respectively whereas the daily average intake was  $0.221 \pm 0.010$  kg and  $0.223 \pm 0.010$  kg respectively. Feed intake was slightly influenced by hot water treatment. The average feed conversion ratios of group I and group II were recorded as  $1.85 \pm 0.445$  and  $1.79 \pm 0.433$  respectively. Average feed conversion ratio was found to be apparently better in piglets kept on floor with hot water treatment (Group II). This revealed that feed was more efficiently utilized for growth by the piglets reared on hot water treated floor (Group II).

The diarrhoea incidence rate was recorded as  $13.11 \pm 5.81$  in Group I which was higher than that of Group II piglets with a value of  $6.39 \pm 2.75$ . The data expresses that the overall diarrhoea incidence rate was higher in Group I piglets than Group II. The mortality was 11.11 percent in group I and no mortality was observed in group II and this is suggestive of better effect of hot water on floors.

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**Abstract of M.Sc. thesis**

**Department: Livestock Production and Management**

**Major Adviser: Dr. Jitendra Saharia**

## **Growth Performance of Crossbred Calves Fed Molasses and Probiotics Supplemented Diet**

*Sanidur Ahmed*

The present experiment was conducted to investigate the effect of feeding molasses and probiotics on the growth performance of crossbred dairy calves. Twelve healthy crossbred calves of both sexes of similar age and body weight were allocated to two experimental groups, control (T0) and treatment (T1) with six animals in each group. Calves of both groups were fed with a standard basal diet consisting of concentrate, green fodder, and paddy straw along with Molasses @ 3% of DM requirement and multi-strain probiotics @10 gm/animal/day daily in the treatment group. The experiment was conducted as a feeding trial for six fortnights and a digestibility trial thereafter for five days in the two experimental groups.

The average initial and final body weight in the 6th fortnight of the calves were 89.500±7.843 and 89.500±8.290 kg and 110.667±7.932 and 119.500±7.178 kg respectively in T0 and T1 groups. Analysis of variance of the data did not reveal any significant difference ( $P>0.05$ ) in average body weight in the control (T0) and treatment (T1) groups.

The overall mean daily body weight gain is 0.357±0.019 kg in the treatment group (T1) which was significantly ( $P<0.01$ ) higher than the control group which is 0.252 ± 0.013 kg. In respect of different fortnights, the Average daily gain was significantly ( $P<0.01$ ) higher from the 4th to 6th fortnight. Similarly, the overall fortnightly body weight gain was significantly higher ( $P<0.01$ ) in the treatment group (5.000 ± 0.270 kg) than in the control group (3.556 ± 0.171 kg) of calves. The fortnightly body weight gain was higher ( $P<0.01$ ) in the treatment group than in the control group from the 2nd to 6th fortnight.

The overall mean values of the conformation traits (cm) in the control group (T0) and treatment group (T1) groups respectively were: 97.17± 1.21 and 99.08 ±1.15 cm for body length; 111.69 ±1.12 and 112.64± 1.06 cm for chest girth as well as 100.23± 0.90 and 100.85 ±0.86 cm for height at wither. All the conformation traits revealed a highly positive correlation with body weight. Analysis of variance of

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**Abstract of M.Sc. thesis**

**Department: Livestock Production and Management**

**Major Adviser: Dr. J. P. Bordoloi**

conformation traits showed no significant ( $P>0.05$ ) difference between control (T0) and treatment (T1) groups respectively.

The overall average daily DM intake was  $2.76 \pm 0.09$  kg in the control group (T0) and  $2.84 \pm 0.09$  kg in the treatment group (T1). Feeding of Molasses and multistrain probiotics had a positive effect on dry matter intake in the treatment group and it was higher than the control group in all fortnights. However, analysis of variance results revealed no significant ( $P>0.05$ ) difference between the average values of DM intake between control (T0) and treatment (T1) groups.

The overall mean values of the feed-eating time were  $243.21 \pm 0.58$  min. in the control (T0) and  $240.42 \pm 0.54$  min. in the treatment (T1) group. Analysis of variance revealed that there was a significant ( $P<0.05$ ) difference between overall average feed-eating time in the control (T0) and treatment (T1) groups. The feed-eating time was reduced significantly ( $P<0.05$ ) in the treatment group (T1) from the 2nd to 6th fortnight.

The average FCR values were  $11.77 \pm 0.79$  and  $10.89 \pm 1.00$  in 1st fortnight and  $10.74 \pm 0.39$  and  $6.39 \pm 0.68$  in the 6th fortnight in control (T0) and treatment (T1) groups respectively. On an overall basis, FCR values were  $10.89 \pm 0.24$  and  $8.35 \pm 0.40$  in the control (T0) and treatment (T1) groups. Analysis of variance revealed that there was a highly significant ( $P<0.01$ ) effect of supplementation of Molasses and probiotics on the feed conversion ratio (FCR) of the experimental animals. Further, the C.D. test revealed that the FCR in the treatment (T1) group was significantly reduced from the 3rd fortnight to the 6th fortnight compared to the control (T0) group. The overall mean values of the physiological parameters in the T0 and T1 groups respectively were as: respiration rate,  $26.17 \pm 0.09$  and  $26.45 \pm 0.11$  breath per minute; pulse rate,  $72.04 \pm 0.13$  and  $72.00 \pm 0.12$  beats per minute and rectal temperature,  $101.07 \pm 0.11$  and  $100.95 \pm 0.11$  (°F). Analysis of the variance of the data revealed no significant ( $P>0.05$ ) difference in respect of the three parameters between the control (T0) and treatment (T1) groups. The blood biochemical and hematological parameters like serum glucose, serum total protein, and hemoglobin were within the normal range for crossbred calves in both the control and treatment groups and the data did not reveal any significant difference ( $P>0.05$ ). The average digestibility coefficient (%) in T0 and T1 groups respectively were:  $67.47 \pm 0.26$  and  $73.33 \pm 0.44$  for dry matter (DM);  $70.37 \pm 1.55$  and  $76.17 \pm 0.44$  for organic matter (OM);  $66.67 \pm 0.73$  and  $71.67 \pm 0.44$  for crude protein (CP);  $66.40 \pm 0.49$  and  $72.63 \pm 0.27$  for ether extract (EE);  $63.97 \pm 0.27$  and  $72.37 \pm 0.18$  for crude fibre (CF) and  $73.40 \pm 1.06$  and  $79.26 \pm 0.73$  for nitrogen-free extract (NFE). Analysis of the data revealed significantly ( $P<0.01$ ) higher digestibility of the organic nutrients in molasses and probiotics fed treatment (T1) group than control (T0) group.

The economic analysis of the cost of feeding the experimental calves revealed the following: (i) average daily cost of feed consumption (on DM basis) per calf was Rs. 42.53 and Rs. 49.06, (ii) average net cost of feed consumption (on DM basis) per calf were Rs. 3572.81 and Rs. 4121.04, (iii) cost of feeding per kg body weight gain was Rs. 167.50 and Rs. 137.37 in control (T0) and treatment (T1) respectively. From the results, it was observed that the total cost of feeding was a little higher in the treatment group

than in the control group. However, the total body weight gain was higher in the treatment group (T1) than in the control group (T0) which resulted in a lower cost of feeding per kg weight gain in the treatment than in the control group.

## **Performance of Assam Hill Goat Reared on Periodically Disinfected Floor**

*Santana Das*

A study was carried out to see the performance of Assam Hill Goat reared on disinfected floors. A total number of 18 Assam Hill Goats (9 males and 9 females) were selected and divided into 3 groups; each consists of 6 goats of an equal number of males and females which were intensively housed. The 3 groups were randomly assigned to the following treatments, *viz.* floor without any disinfectant treatment (T<sub>1</sub>), floor treated with sodium hypochlorite (T<sub>2</sub>) and floor treated with calcium oxide i.e. quicklime (T<sub>3</sub>).

The fortnightly average initial body weight of the selected goats of T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> groups were  $6.01 \pm 0.16$ ,  $6.23 \pm 0.16$  and  $6.21 \pm 0.17$  kg respectively and the corresponding value for the same groups at 6<sup>th</sup> fortnight were  $10.45 \pm 0.17$ ,  $11.93 \pm 0.23$  and  $11.38 \pm 0.22$  kg respectively. Statistical analysis of the data exhibited significant differences among the groups from the 4<sup>th</sup> to 6<sup>th</sup> fortnight ( $P < 0.05$ ). Goats reared on a floor treated with sodium hypochlorite showed higher body weight followed by calcium oxide treated floor during the entire experimental period, however, the difference appeared to be non-significant up to 3<sup>rd</sup> fortnight. The critical difference test reveals that there was a significant difference between T<sub>1</sub> and T<sub>2</sub> groups but no significant difference could be observed between T<sub>1</sub> and T<sub>3</sub> as well as T<sub>2</sub> and T<sub>3</sub> groups.

The body weight gains of goats for T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> groups in the 1<sup>st</sup> fortnight figured as  $0.52 \pm 0.09$ ,  $0.60 \pm 0.08$  and  $0.57 \pm 0.08$  kg and the corresponding values for the same 3 groups in the 6<sup>th</sup> fortnight were recorded as  $1.14 \pm 0.11$ ,  $1.54 \pm 0.10$ , and  $1.37 \pm 0.10$  kg respectively. The average daily body weight gain of goats for T<sub>1</sub> was  $0.035 \pm 0.005$  kg, T<sub>2</sub> was  $0.040 \pm 0.006$  kg and T<sub>3</sub> was  $0.038 \pm 0.005$  kg in the 1<sup>st</sup> fortnight and the corresponding values for the same groups in the 6<sup>th</sup> fortnight were recorded as  $0.076 \pm 0.007$  kg,  $0.100 \pm 0.006$  kg, and  $0.091 \pm 0.006$  kg respectively. The fortnightly body weight gain and daily body weight gain manifested a significant difference ( $P < 0.05$ ) statistically in 6<sup>th</sup> fortnight. The critical difference test reveals that there was a significant difference between T<sub>1</sub> and T<sub>2</sub> groups but found no significant difference between T<sub>1</sub> and T<sub>3</sub> as well as T<sub>2</sub> and T<sub>3</sub> groups.

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**Abstract of M.Sc. thesis**

**Department: Livestock Production and Management**

**Major Adviser: Dr. Adib Haque**

The average dry matter intake of goats in T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> were  $4.05 \pm 0.113$ ,  $4.48 \pm 0.120$  and  $4.37 \pm 0.117$  kg in the 1<sup>st</sup> fortnight respectively and the corresponding values for the same 3 groups in the 6<sup>th</sup> fortnight were recorded as  $6.59 \pm 0.101$ ,  $7.51 \pm 0.174$ , and  $7.34 \pm 0.163$  kg respectively. There was a statistically significant difference ( $P < 0.05$ ) from 4<sup>th</sup> to 6<sup>th</sup> fortnight and the critical difference test revealed a significant difference between T<sub>1</sub> and T<sub>2</sub> groups but could not exhibit any significant difference between T<sub>1</sub> and T<sub>3</sub> as well as T<sub>2</sub> and T<sub>3</sub> groups.

The feed conversion ratios for T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> goats in the 1<sup>st</sup> fortnight figured as  $7.80 \pm 0.18$ ,  $7.38 \pm 0.17$  and  $7.65 \pm 0.18$  and the corresponding values for the same 3 groups in the 6<sup>th</sup> fortnight were  $5.80 \pm 0.12$ ,  $4.88 \pm 0.10$ , and  $5.36 \pm 0.11$  respectively. The feed conversion ratio was found to be highly significant ( $P < 0.01$ ) from 4<sup>th</sup> to 6<sup>th</sup> fortnight. This revealed that feed was more efficiently utilized for growth by the goats reared on sodium hypochlorite treated floor (T<sub>2</sub>). The critical difference test reveals that there was a significant difference between T<sub>1</sub> and T<sub>2</sub> groups in 4<sup>th</sup> fortnight but no such differences could be seen between T<sub>1</sub> and T<sub>3</sub> as well as T<sub>2</sub> and T<sub>3</sub> groups. But from 5<sup>th</sup> fortnight onwards there was a significant difference among all the three groups.

The incidence rate of diarrhea of goats was recorded as 40% for T<sub>1</sub>, 18% for T<sub>2</sub> and 40% for T<sub>3</sub> in the 1<sup>st</sup> fortnight. No incidence of diarrhea was observed from 4<sup>th</sup> fortnight onwards in all the groups. The data expressed that the overall diarrhea incidence rate was higher in T<sub>1</sub> goats intermediate in T<sub>3</sub> and lowest in T<sub>2</sub>.

The parasitic infestation of goats was recorded as 83% in T<sub>1</sub>, 66% in T<sub>2</sub> and 83% in T<sub>3</sub> groups in the 1<sup>st</sup> fortnight. The data further reveals that the overall parasitic infestation of goats was found to be lowest in T<sub>2</sub> goats followed by T<sub>3</sub> and T<sub>1</sub>.

## **Study on The Indigenous Knowledge System on Pig Rearing Adopted by The Rabha Community of Assam**

*Sayashree Rabha*

A study on the indigenous knowledge system on pig rearing adopted by the Rabha community of Assam was conducted for which farmers from two districts namely Kamrup and Goalpara were selected having atleast 2 pigs. The study was carried out to know the socio-economic status of the pig farmers, managerial practices adopted by them and the use value of pig in the socio-cultural life of the Rabha farmers. Majority of the farmers involved in pig rearing were females (58.67 %), 67.00 % belonged to the middle age group (29-52 years), 60.00 % had high school level of education, 83.33 % of the pig farmers had medium family size (3-5 members) and majority (65.33 %) were agri-farmers. About 71.33 % of the farmers had medium land holding (0.90-4.00 acres) and 91.00 % reared 2-6 numbers of pigs. The average total annual income of the pig farmers was Rs.103700.00±3180.84 and average annual income from piggery was Rs.49670.00±2484.26 Share of piggery to the total income of farmer was 47.89 %. Extensive system of rearing (78.33 %) along with tethering (52.67 %) was predominant and pigs were fed Indigenous or locally available feedstuff (92.67 %). Majority of the pig farmers reared cross breed pigs (85.00 %), followed by non-descript pigs (14.00 %) for fattening purpose (86.66 %). Natural service (87.33 %) was mostly practiced for breeding with average litter size at birth 10.3±0.38 and at weaning 9.13±0.35. About 41.33 % farmers did not take any disease preventive and treatment measures, only 77.33 % of the farmers did castration of piglets, 7.67 % took special care of pregnant and farrowing sows, 46.33 % carried out deworming and 15.33 % vaccinated their pigs. Only 15.00 % of the farmers acquired piggery management training. Majority of the pig farmers (74.33 %) sold their pigs directly to agent or wholesaler at the age of 6 months and above (73.00 %) and 51.00 % bought their piglets from local markets, 58.00 % of the farmers sold pigs due to urgency of money. The average age of pigs at the time of marketing was 234.98±4.7 days, average sale price of piglet was Rs.3560.33 ± 14.50, pig was Rs.13834.00 ± 326.00 and pork per kg was

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**Abstract of M.Sc. thesis**

**Department: Livestock Production and Management**

**Major Adviser: Dr. Naba Kumar Sarma**



Rs.313.53±1.22. Major constraint faced by the farmers was lack of finances for purchasing of new animals, feed, building pig sty or farm etc. (39.33 %). Majority of the farmers reared pigs as financial security during emergency (70.33 %). About 38.00 % reared pigs for social occasions, 14.00 % reared for the Baikho festival and 3.33 % reared for wedding rituals. It was also found that only 37.67 % of the farmers thought that piggery could be taken up as a primary occupation.

## Shelf Life of Raw Cow Milk in Different Temperatures

*Subarna Sarkar*

An experiment was conducted to investigate the shelf life of raw cow milk of organised and unorganised farms of Khanapara, Guwahati during summer and winter seasons. A total of 24 milk samples were collected aseptically from pooled milk of the unit after thorough mixing of all the milk with sterile plunger produced in the unit and brought to the laboratory for analysis maintaining the cold chain.

The milk samples were subjected to qualitative and physio-chemical assessment and microbiological assessment.

The milk samples of the organized farm had significantly higher overall average percentage of fat ( $4.03 \pm 0.13$  and  $3.56 \pm 0.18$ ), SNF ( $9.37 \pm 0.05$  and  $8.65 \pm 0.18$ ), protein ( $3.60 \pm 0.02$  and  $3.38 \pm 0.08$ ), lactose ( $5.38 \pm 0.04$  and  $4.99 \pm 0.10$ ), and ash ( $0.77 \pm 0.01$  and  $0.69 \pm 0.01$ ) content in organised farm than in unorganized farm. It was observed that fat, protein, lactose were higher in winter than in summer season.

Specific gravity was higher in organised farm than in unorganised farm ( $1.0331 \pm 0.0026$  and  $1.0311 \pm 0.0062$ ) while season had no effects. Freezing point depression is non-significant in respect of both farms ( $0.64 \pm 0.00$  and  $0.58 \pm 0.02$ ) and seasons ( $0.59 \pm 0.01$  in summer and  $0.62 \pm 0.01$  in winter). Rapid platform tests namely (i) organoleptic evaluation (colour, taste, smell) were found to be *normal* both in organised and unorganised farms in both the seasons, (ii) COB, Alcohol test were *negative* both in respect of farms and seasons and (iii) Resazurin test results of milk were more *superior and acceptable* in unorganised and winter season compare to organised farm and summer season. Physio-chemical parameters e.g. pH ( $6.90 \pm 0.05$  and  $6.73 \pm 0.06$ ) and titratable acidity ( $0.17 \pm 0.01\%$  and  $0.16 \pm 0.00\%$ ) was nonsignificant in respect of farms, while pH ( $6.66 \pm 0.03$  in summer and  $6.97 \pm 0.04$  in winter) and titratable acidity ( $0.18 \pm 0.01$  in summer and  $0.16 \pm 0.01$  in winter) were significantly ( $P < 0.01$ ) lower and higher respectively in summer that indicating higher microbial load in summer. The MBRT results of milk was graded as *excellent* in winter and *good* in summer season in both organised and unorganised farm. TVC and coliform count in milk was significantly

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**Abstract of M.Sc. thesis**

**Department: Livestock Production and Management**

**Major Adviser: Dr. Jitendra Saharia**

( $P < 0.01$ ) higher in organised farm and in summer season in different periods compared to unorganised farm and winter season.

The results revealed that the milk collected from organised farm in both the seasons contained higher SNF, fat, protein, lactose and ash but the microbiological quality of milk of unorganised farm was superior to that of organised farm.

## **Effect of Supplementing Garlic Powder on The Performance of The Sahiwal Calves**

*Zara Kaku Sorang*

The present experiment was conducted to investigate the effect of supplementing garlic powder on the performance of Sahiwal calves. Twelve healthy Sahiwal calves of both sexes of similar age and body weight were allocated to two experimental groups, control (T0) and treatment (T1) with six animals in each group. Calves of both groups were fed with a standard basal diet consisting of concentrate, green fodder, and paddy straw. While in the treatment group, garlic powder was supplemented @ 250 mg/kg body weight along with concentrate feed. The experiment was conducted as a feeding trial for eight fortnights and a digestibility trial thereafter for five days in the two experimental groups.

The average initial and final body weights in the 8th fortnight of the calves were  $81.81 \pm 0.34$  and  $81.46 \pm 0.35$  kg and  $148.75 \pm 0.40$  and  $153.84 \pm 0.38$  kg respectively in T0 and T1 groups. Analysis of the variance of the data revealed a highly significant difference ( $P < 0.01$ ) in average body weight in the control (T0) and treatment (T1) groups.

The overall fortnightly body weight gain was significantly higher ( $P < 0.01$ ) in the treatment group ( $603 \pm 17.00$  g) than in the control group ( $558 \pm 17.00$  g) of calves. The fortnightly body weight gain was higher ( $P < 0.01$ ) in the treatment group than in the control group from the 1st to 8th fortnight.

The overall average daily DM intake was  $2.98 \pm 0.06$  kg in the control group (T0) and  $2.97 \pm 0.07$  kg in the treatment group (T1). Feeding of garlic powder in treatment (T1) had no significant effect on dry matter intake all fortnights. Also, analysis of variance results revealed no significant ( $P > 0.05$ ) difference between the average values of DM intake between control (T0) and treatment (T1) groups.

The average FCR values were  $6.10 \pm 0.07$  and  $5.26 \pm 0.08$  in 1st fortnight  $4.88 \pm 0.05$  and  $4.73 \pm 0.06$  in the 8th fortnight in control (T0) and treatment (T1) groups respectively. On an overall basis, FCR values were  $5.42 \pm 0.06$  and  $4.96 \pm 0.04$  respectively in the control (T0) and treatment (T1) groups. Analysis of variance revealed that there was a highly significant ( $P < 0.01$ ) effect of supplementation of garlic powder

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**Abstract of M.Sc. thesis**

**Department: Livestock Production and Management**

**Major Adviser: Dr. Dilip Kumar Baruah**

on the feed conversion ratio (FCR) of the experimental animals. Further, the C.D. test revealed that the FCR in the treatment (T1) group was significantly reduced from the 2nd fortnight to the 8th fortnight compared to the control (T0) group.

The overall mean values of the conformation traits in the control group (T0) and treatment group (T1) groups respectively were: 74.53±2.12 and 79.31±2.41 cm for body length; 86.40±1.74 and 90.80±1.91 cm for chest girth as well as 78.22±2.00 and 82.18±2.10 cm for height at wither. All the conformation traits revealed a highly positive correlation with body weight. Analysis of variance of conformation traits showed highly significant ( $P<0.01$ ) difference between the control (T0) and treatment (T1) groups respectively.

The overall mean values of the physiological parameters in the T0 and T1 groups respectively were as: respiration rate, 28.61±0.21 and 28.79±0.14 breath per minute; pulse rate, 72.20±0.07 and 72.20±0.07 beats per minute and rectal temperature, 101.36±0.04 and 101.30±0.03 °F. Analysis of the variance of the data revealed no significant ( $P>0.05$ ) difference in respect of the three parameters between the control (T0) and treatment (T1) groups.

The blood biochemical and hematological parameters like serum glucose, serum total protein, RBC and hemoglobin were within the normal range for Sahiwal calves in both the control and treatment groups. Serum glucose data did not reveal any significant difference ( $P>0.05$ ), while serum total protein, RBC and Hemoglobin showed highly significant ( $P<0.01$ ) difference between control and treatment group. The average digestibility coefficient (%) in T0 and T1 groups respectively were: 67.73±0.12 and 73.41±0.14 for dry matter (DM); 71.08±0.2 and 76.28±0.14 for organic matter (OM); 66.73±0.25 and 71.76±0.14 for crude protein (CP); 66.50±0.17 and 72.69±0.08 for ether extract (EE); 63.97±0.27 and 72.37±0.18 for crude fibre (CF) and 73.40 ±1.06 and 79.26±0.73 for nitrogen-free extract (NFE). Analysis of the data revealed significantly ( $P<0.01$ ) higher digestibility of the organic nutrients in garlic powder supplemented treatment (T1) group than control (T0) group. The economic analysis of the cost of feeding the experimental calves revealed the following: total DM consumption per calf was 357.19 and 356.02 kg, cost of per kg feed (DM) was Rs. 15.42 and 15.42, and the cost of feed per group was Rs. 5532.87 and 5489.90, the total cost of garlic powder Rs. 0.00 and Rs. 300, the net cost of feed per day per calf was Rs. 5532.87 and Rs. 5789.90, net feed cost per day per calf Rs. 46.12 and 48.25, weight gain per calf was 30.00 and 32.65 kg, and finally cost of feeding per kg gain was Rs. 184.42 and 177.33 in control (T0) and treatment (T1) respectively. From the results, it was observed that the total cost of feeding was a little higher in the treatment group than in the control group. However, the total body weight gain was higher in the treatment group (T1) than in the control group (T0) which resulted in a lower cost of feeding per kg weight gain in the treatment than in the control group. The present study revealed that the supplementation of garlic powder at dosage of 250 mg/kg body weight in the Sahiwal calf ration is beneficial in terms of body weight gain, feed conversion ratio,

body confirmation traits, hematological parameters, blood biochemicals , digestibility coefficient (%) and economic of feeding.

# Quality Characteristics of Soy Milk Blended Yoghurt

*Arifa Khatun*

A study was carried out to evaluate the quality characteristics of soy milk blended cow's milk yoghurt. The study was carried out in the laboratories of the Department of Livestock Products Technology, the All India Coordinated Research Project on Post-Harvest Engineering and Technology, the Department of Veterinary Biochemistry, College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati- 781022 and in the Central Analytical Instrumentation Facility, Guwahati Biotech Park Incubation Centre, Amingaon, Kamrup, Guwahati-781031 during the period from December, 2021 to September, 2022.

Organic whole soybeans procured from the local super markets were used for preparing sprouted and unsprouted soy milk. The NCDC 144 obtained from the National Dairy Research Institute, Karnal was used @ 3% (v/v) as yoghurt starter culture in the study.

The effects of addition of soy milk on the pH, per cent lactic acid content, free fatty acids, flavour and colour profile, proximate composition, microbiological quality, sensory scores and the best before end of the cow's milk yoghurt were studied.

A gradual decrease in the pH values of the Control samples as well as in all the samples of the Treatment groups was noted. Fatty acids and flavour compounds were identified with the help GC-MS. The colour profiling revealed that L, a and b values were the highest in control samples followed by T2 group while the samples of T1 group showed the least values for these colour components.

The samples of T2 group contained the maximum mean values of  $4.23 \pm 0.02$ ,  $19.65 \pm 0.10$  and  $1.26 \pm 0.00\%$  for protein, total solids and ash, respectively, while the Control samples showed the maximum mean value of  $4.37 \pm 0.03$  and  $82.96 \pm 0.12\%$  for fat and moisture, respectively. The protein content of the cow's milk yoghurt incorporated with 25% of soy milk had higher protein content than the cow's milk yoghurt. Addition of sprouted soymilk increased the per cent protein content of the cow's milk yoghurt than those incorporated with unsprouted soymilk.

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**Abstract of M.Sc. thesis**

**Department: Livestock Products Technology**

**Major Adviser: Dr. (Mrs.) T. Borpuzari**

The highest mean TVC of  $9.13 \pm 0.01 \log_{10} \text{cfu/ml}$  was recorded in the samples of the T2 group which might be due to rapid growth of the added starter organisms accelerated by the synergistic effect of the germination metabolites of soybeans. Coliforms, *E. coli*, *Salmonella*, *Shigella*, *Staph. aureus* and yeast and moulds were not detected in any of the samples.

The cow's milk yoghurt prepared with 25% unsprouted soymilk had higher contents of caproic, caprylic, and lauric acids over the control samples. The yoghurt prepared with 25% sprouted soymilk had higher concentrations of margaric, palmitoleic, proprionic, tricosylic, tridecylic and vaccenic acids as compared to the control as well as the unsprouted samples. These free fatty acids might have contributed to the typical flavour of soy blended cow's milk yoghurt.

The cow's milk yoghurt blended with 25% of unsprouted and sprouted soy milk enjoyed identical panel acceptance for the appearance, colour, body and texture, and flavour characteristics indicating that soy milk could be successfully blended with cow's milk up to 25% in yoghurt without affecting its sensory properties. However, the cow's milk yoghurt was more preferred for its taste as compared to the soy milk blended yoghurts. Cow's milk yoghurt blended with 25% soy milk had the 'Best Before End' of 5d at refrigeration temperature.



## **Development of Duck Meat Sausages Incorporated with Foxtail Millet (*Setaria italica*)**

*Kiran Moya Handique*

The present study was aimed to develop duck meat sausages by incorporating three different levels of roasted foxtail millet flour (*Setaria italica*) (5%, 10% and 15%) and other non-meat ingredients. The best formulation/combination that can be stored reasonably at refrigeration temperature without affecting its physicochemical, sensory and microbiological qualities was estimated. A total of five batches of each formulation were prepared with the following formulations- Control (0% FTMF), T<sub>1</sub> (5% FTMF), T<sub>2</sub> (10% FTMF) and T<sub>3</sub> (15% FTMF). The stuffed raw sausages of each formulation were cooked in a cooking vat maintained at 85°C for 45 minutes. After that, these were packed in food-grade polyethylene bags, stored under refrigeration temperature and evaluated for various quality traits viz., pH, Water Activity (a<sub>w</sub>), Thiobarbituric acid reactive substance (TBARS) value, Water Holding Capacity (WHC), Sensory qualities, Total Viable Count (TVC), Total Viable Psychrophilic Bacterial Count (TVPBC) and Colititre value on 1<sup>st</sup>, 5<sup>th</sup>, 10<sup>th</sup> and 15<sup>th</sup> days of storage. In addition, the Emulsion Stability (ES), Cooking Yield, Proximate Composition, Colour Profile and Texture Profile of the products were estimated on the day of production (1<sup>st</sup> day). Besides the above, the Calorie value and production cost of duck meat sausages were estimated.

The ES revealed highly significant differences (p<0.01) between the control and the treated products. The cooking yield was significantly (p<0.05) higher in formulations treated with FTMF than in control. The results of the present study indicate that the pH of the products differed significantly (p<0.01) between the control and treated formulations during the entire storage period. The a<sub>w</sub> and the TBARS values decreased significantly (p<0.01) from control to T<sub>3</sub>. The results for the WHC showed the highest value for the T<sub>3</sub> sample. During storage at refrigeration temperature (4±1°C), the pH, a<sub>w</sub>, and WHC showed a decreasing trend with the increase in storage period. However, the TBARS values increased significantly (p<0.01) up to 15 days of storage. The sensory scores of the duck meat sausages for all attributes at 5% level of foxtail millet flour incorporation were quite comparable with control. TVC and TVPBC showed a significantly (p<0.01) decreasing trend from control to treated products.

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However, the bacterial load increased during the storage for up to 15 days. No coliform and yeast and mould were detected during the entire storage period. The moisture, crude protein, ether extract and calorific value declined from control to treated products, while the ash content was highest for T<sub>3</sub>. The colour profile revealed no significant ( $p>0.01$ ) difference in lightness(L\*), redness(a\*) and yellowness(b\*). A highly significant difference ( $p<0.01$ ) was observed between control and treated products in the springiness of the duck meat sausages. Significant differences ( $p<0.05$ ) were also observed between control and treated sausages in hardness, chewiness and resilience. However, in cohesiveness, non-significant ( $p>0.05$ ) differences were observed between the control and the treated products. The cost of production revealed that duck meat sausages prepared with the incorporation of 15% foxtail millet flour (T<sub>3</sub>) were more cost-effective than the control duck meat sausages.

Based on the above findings, it might be concluded that value-added, nutritionally balanced duck meat sausages could be made with the incorporation of 15% FTMF (T<sub>3</sub>) without adversely affecting its quality and were acceptable for 15 days when stored under aerobic packaging and at refrigeration temperature ( $4\pm 1^{\circ}\text{C}$ ). However, among the treated products, duck meat sausages with 5% level of foxtail millet flour (T<sub>1</sub>) was found to be the best one in terms of overall quality parameters.

## **Development of Enzyme Based Chromogenic Strips for Detection of Selected Adulterants in Milk**

*Priya Muktan*

The present investigation was carried out to develop an enzyme based chromogenic strip for detection of selected adulterant in milk. The experiment was carried out in the Department of Livestock Products Technology, All India Coordinated Research Project on Post Harvest Engineering and Technology and Department of Veterinary Biochemistry, College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati-781022.

An enzyme based chromogenic test strip using Whatman filter paper grade 602 and Whatman filter paper No. 1 was developed for the detection of glucose, starch and urea in milk using glucose oxidase, amyloglucosidase and urease enzyme in the presence of potassium iodide for starch and glucose and phenol red for urea as an indicator. The activity of the test strip was validated in both raw and processed milk spiked with the respective adulterants.

All the enzyme based test strips were able to detect 2mg/ml of glucose, starch and urea with definite ring formation within a specified time period. The response time for the detection of glucose, starch and urea in milk was noted at  $31.22 \pm 0.014$  and  $30.00 \pm 0.05$ ,  $128.3 \pm 0.88$  and  $129 \pm 0.57$  &  $99 \pm 0.57$  and  $109.67 \pm 0.88$  sec, respectively in Whatman filter paper grade 602 and Whatman filter paper No. 1 at a pH of 4.5, 4.5 and 8.0 and a chromogenic substrate concentration of 40, 50 and 1 mg/ml. The optical density of glucose, starch and urea was found to be almost linear. As the concentration of the substrate increase the optical density value tends to increase proportionately.

The test strip was tested for true positive and true negative results. The limit of detection for glucose, starch and urea were found to be 1.0, 2.0 and 0.8 mg/ml, with response time of 1, 4 and 3 min, respectively.

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**Abstract of M.Sc. thesis**

**Department: Livestock Products Technology**

**Major Adviser: Dr. Masuk Raquib**

To see the effect of different processing condition on the ability to degrade glucose, starch and urea in milk, all the test strips showed positive response except in household boiling condition wherein the response was delayed by a few min. The enzyme based test strip were 100 percent specific for detection of glucose, starch and urea as presence of similar types of compounds did not interfere with the positivity rate of the strips which was verified with help of confusion matrix.

The shelf life of enzyme based chromogenic glucose, starch and urea test strips were found to be 40 and 30, 34 and 30 & 42 and 34 d, respectively for Whatman filter paper grade 602 and Whatman filter paper No. 1, respectively when stored under refrigerated storage ( $7\pm 1^{\circ}\text{C}$ ) and ambient storage ( $29\text{-}32^{\circ}\text{C}$ ) condition in airtight glass containers.

## **Seroprevalence and Molecular Detection of Bovine Brucellosis and Leptospirosis in Assam**

*Bandana Devi*

Brucellosis and leptospirosis are neglected zoonotic disease prevalent throughout the world. Bovine brucellosis is predominantly caused by *Brucella abortus*. Leptospirosis in bovine is mainly caused by *Leptospira* serovars under the serogroup Sejroe. Both the diseases share some common clinical signs and symptoms and cause severe economic losses. The present study was undertaken to estimate the seroprevalence of bovine brucellosis and leptospirosis and diagnose both the diseases by molecular detection of *Brucella* and *Leptospira* organisms in clinically suspected and seropositive cases. The study was carried out in Assam during August 2021 to July, 2022.

In this study, a total of 1013 cattle serum samples were collected from 11 districts of Assam viz. Tinsukia, Lakhimpur, Dhemaji, Sonitpur, Nagaon, Kamrup-M, Barpeta, Udalguri, Kokrajhar, Dhubri and Cachar, and screened for *Brucella* antibody by Rose Bengal Plate Test (RBPT) and Indirect-enzyme Linked Immunosorbent Assay (i-ELISA) to estimate the seroprevalence of the disease. To detect seroprevalence of leptospirosis, a total of 512 cattle serum samples were collected from 7 districts of Assam viz. Dhemaji, Bishwanath, Nagaon, Kamrup-M, Bongaigaon, Kokrajhar and Dhubri, and tested by i-ELISA for *Leptospira* antibody. A total of 41 serum samples were found to be positive for *Brucella* antibody by both the tests with a seroprevalence rate of 4.04% and 19 out of 512 serum samples were found to be positive for *Leptospira* antibody by i-ELISA with a seroprevalence rate of 3.71%. Higher seroprevalence of brucellosis was recorded in female (4.60%) than in male animals (2.16%). Similarly, higher seroprevalence of leptospirosis was recorded in female (4.53%) than in male animals (1.45%). Age wise seroprevalence of brucellosis was found to be highest in animals of 2.1 to 5 years (1st to 3rd lactation) of age (6.32%) followed by animals of 5.1 years and above (4th lactation onwards) age group (2.90%). In case of leptospirosis, animals of 5.1 years and above (4th lactation onwards) age group showed highest seroprevalence (7.47%) followed by animals of 2.1 to 5 years (1st to 3rd lactation) of age (4.14%).

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**Major Adviser: Dr. G. K. Saikia**

In both brucellosis and leptospirosis, higher seroprevalence rate i.e., 6.54% and 4.33%, respectively was recorded in crossbred than in local cattle (1.07% and 2.97%, respectively). In case of brucellosis, animals reared in organised farms showed higher seroprevalence (8.94%) than the animals reared in semi-organised (3.08%) and backyard farms (1.63%). On the other hand, in case of leptospirosis, animals reared in backyard farms showed higher seroprevalence (7.20%) than the animals reared in semi-organised (2.63%) and organised farms (2.47%). In relation to animal health status, the seroprevalence of both the diseases were found to be highest in clinically ill animals with 40.90% for brucellosis and 8.18% for leptospirosis than apparently healthy animals i.e., 3.22% for brucellosis and 3.06% for leptospirosis. Again, among clinically ill animals, seropositivity for brucellosis was highest in animals with history of abortion (66.66%) followed by animals with retention of placenta (50.0%) and repeat breeding (33.33%). Similarly, in case of leptospirosis, highest seroprevalence was found in animals with history of abortion (33.33%) followed by animals with retention of placenta (25.0%) and repeat breeding (13.33%).

In this study, both *Brucella* and *Leptospira* antibodies could be detected in 5 out of 512 serum samples screened by i-ELISA specific for both the diseases with a seropositivity rate of 0.976%.

For molecular detection of brucellosis, 41 seropositive (32 apparently healthy and 9 clinically ill) and 23 clinically suspected (seronegative) samples (whole blood, aborted foetus, placenta, vaginal swab) were tested by *Brucella* genus specific PCR. Out of these, 9 clinical samples (39.13%) from seronegative cases and 4 samples (9.75%) from seropositive cases were found to be positive for *Brucella* genomic DNA in *Brucella* genus specific *bcs31* PCR. Overall, out of 64 samples examined, *Brucella* genomic DNA could be detected in 13 number of samples with a positivity rate of 20.31%. All 13 *Brucella* DNA were confirmed as *Brucella abortus* by multiplex PCR (AMOS). For molecular detection of leptospirosis, 19 seropositive (15 apparently healthy and 4 clinically ill) and 33 clinically suspected (seronegative) samples (whole blood, aborted foetus, placenta, vaginal swab and urine) were tested by *Leptospira lipL32* gene PCR. Out of 33 clinically suspected (seronegative) samples, *Leptospira* DNA could be detected in 6 number of samples with positivity rate of 18.18%. *Leptospira* DNA could not be detected from seropositive samples. As a whole, out of 52 samples, *Leptospira* DNA could be detected in 6 sample with an overall positivity rate of 11.53%.

## **Neutralization Efficacy of Classical Swine Fever C-Strain Specific Antibody to Different Genotypes Circulating in North Eastern States, India**

*Jayashree Sarma*

Classical swine fever (CSF) or Hog cholera is a highly contagious viral diseases affecting domestic and wild pigs. It has been a big threat to the piggery sector globally, causing negative impact on the economic background. The disease is highly endemic in India including NER. Assam too records highest CSF outbreaks. The recent outbreaks recorded occurrence of genotype 2.2, 2.1 and 1.2 besides wide prevalence of the historical genotypes 1.1. Outbreaks in vaccinated herds and shift in genogroup 1 to 2 globally, has raised the concern over the antigenic variation, protective immune response and neutralizing capacity of C-strain vaccine antibodies. Thus the present study was undertaken to explore the cross- protection efficacy of C-strain vaccine antibodies to the different genotypes or the need for potential vaccine candidate.

Tissue samples and lyophilized isolates were selected for the study from CSFV repository, Department of Veterinary Microbiology. Sandwich ELISA and nested RT-PCR was done to determine the presence of the virus. Out of total 49 samples, overall positivity in SELISA was 36.0% (18) and in nested RT-PCR was 30.0% (15). The recovery rate of tissue samples was lower (35.0%) in comparison to lyophilized isolate 40.0%.

Molecular characterization of the samples found positive in screening test was done based on E2 full length gene. Five isolates representing each state from north-east was successfully amplified at 1119bp for full length amplification of E2 gene. Genogrouping and phylogentic analysis revealed, genogroups 1.1 and 2.2 circulating in NER showing 98% and 84% nucleotide identity, respectively with the reference Alfort/187 strain. Whereas 99% nucleotide identity within the genogroup.

The five isolates with known genogroups were propagated in PK-15 cell line upto 5th passage level and confirmed by S-ELISA and nested RT-PCR. Four isolates were isolated successfully except the isolate from Assam. The OD value at different passage level ranged from 0.589 to 1.763, showing an increase in titre with each

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subsequent passage. CSFV\_AAU\_Mg01 showed highest OD value at 5th passage. In-situ demonstration of CSFV by IPT revealed reddish brown cytoplasm indicating replication of the virus in the cytoplasm. TCID<sub>50</sub> of the passaged viruses were done by FAT showing comparable titre (4.49-5.16) with that of vaccine strain at 5th passage level. CSFV\_AAU\_Mg01 showing highest log TCID<sub>50</sub> 10 5.16 log TCID<sub>50</sub> per ml.

Hyperimmune sera was raised using purified cell culture adapted lapinised vaccine showing titres of 1:800 and 1:1600 and used for immunological characterization of the isolates by cross neutralization assay. A 50% neutralization titre of the hyperimmune serum ranged from 1/133 to 1/158 when assayed against the different viruses by FAT. Neutralization and cross – neutralization assay with C-strain specific antibody showed 100% neutralization with genotype 1.1, whereas 84% in genotype 2.2.

The study revealed genotypes 1.1 and 2.2 widely circulating in NER with lower neutralization efficacy of vaccine antibodies to heterologous genotypes.



# **Physicochemical properties of live attenuated duck plague vaccine and evaluation of stabilizer efficacy for lyophilization**

*Jonmoni Barua*

Duck plague (DP) or Duck Viral Enteritis (DVE) is an acute contagious herpesvirus infection of ducks and waterfowl of the family Anatidae of the order Anseriformes. Anadid Herpesvirus-1 (AHV-1) or duck enteritis virus (DEV) of the family Herpesviridae is the responsible agent for DP or DVE which is a member. The disease is known to have a global distribution and is associated with significant economic losses worldwide. The only method for preventing and controlling the disease is vaccination. Also, an active decontamination process for an effective vaccination programme in field conditions is important. So, in the present study emphasis has been laid to understand the physicochemical properties of a DPV vaccine strain along with evaluation of thermostability of freeze-dried vaccine with different combinations of stabilizers.

In the present study, a vaccine strain of DPV available in the DBT-ADMaC Department of Veterinary Microbiology, College of Veterinary Science, AAU, Khanapara was revived in CEF and selected for study on the basis of identity with DPV by observing CPE, PCR and molecular characterization. Characteristic CPE like vacuolation, rounding, syncytium formation and ultimately detachment of cells were observed, in case of PCR band was observed at 1510 bp which proves similar identity with DPV. Molecular characterization revealed homology with DPV isolates from India (Kerala and Assam) and China. Quantitation was done at each step to find out the titre by TCID<sub>50</sub>/ml after every evaluation right from initial titre, loss of titre during lyophilization, loss of titre during the evaluation of physicochemical treatment, stability evaluation of the freeze-dried vaccine vial, as well as reconstituted vials.

The initial titre was found to be  $6.9 \pm 0.17$ . The vaccine virus was found to be sensitive to temperatures exceeding 56°C and above, pH 3 and below, and pH 11 and above. It was also found sensitive to ether and trypsin. On sterility test, no growth was found on the culture. Lyophilization was carried out with 3 combinations of stabilizers namely LS, PTI and LHT. On quality evaluation, PTI and LHT showed uniform cake

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formation along with minimal loss of titre due to lyophilization. To check the thermostability of freeze-dried vaccines and reconstituted vaccines, vials were exposed at different temperatures. Among the freeze-dried vaccine, LHT could keep the highest titre when exposed to different temperatures and sampled at different time intervals. Although, LS and PTI too could keep with the infectivity titre with minimal loss of titre. In case of the reconstituted vaccine, NSS showed better stability at different temperatures than PBS, though the differences were minimum between the two.

Finally, it can be concluded that LHT is one of the better stabilizers for DPV freeze-dried vaccine production. Alternatively, LS and PTI can be used by utilizing a suitable freeze-drying protocol. PBS and NSS both can be used as a diluent for the lyophilized DPV vaccine although in this study NSS was found to be superior. Hence, stabilizer LHT with diluent NSS was found to be superior for the DPV vaccine strain under this study.

# **Adaptation of Mesogenic Newcastle Disease Virus (Genotype XIII) in Vero Cell And Its Immunogenic Potential**

*Lewamangphika Rapphap*

The ever-occurring vaccination failures and outbreaks of Newcastle disease (ND) globally and nationally underscore the need to develop genotype-matched vaccines that can reduce outbreaks and viral shedding. The present study describes the adaptation and attenuation of a mesogenic genotype XIII Newcastle disease virus (NDV). The isolate (As/GP/18/92) was obtained from the repository of Department of Veterinary Microbiology under DBT Twinning project on —An integrated omics approach to characterize circulating Newcastle disease virus and intervention strategies to control Newcastle disease in North-East India, College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati-22, Assam. The isolate was adapted in Vero cell line passages up to the 20th passage without addition of any extraneous supplement. Cytopathic effects (CPE) were observed from the 3rd passage onwards which was characterized by grouping, clumping, rounding of the cells at 48 hours post inoculation (hpi) with ultimate detachment of the cell monolayer at 72hpi. At every 5th passage, the growth of the Vero-adapted NDV was confirmed by Haemagglutination assay (HA), virus isolation in 9-to-11-day old Specific Pathogen Free (SPF) embryonated chicken eggs and molecular confirmation by RT-PCR targeting *F* gene (363bp). Sequence analysis of the original (P0) and 20th passage (P20) Vero cell adapted virus revealed no changes in the F-Protein Cleavage Site (FPCS) region. However, nucleotide changes were observed in the M protein region. The TCID<sub>50</sub> values in Log<sub>10</sub>/ml of every 5th passage increased with an increase in passage levels (P5- 10-3.5TCID<sub>50</sub>, P10-10-4.78TCID<sub>50</sub>, P15-10-5.23TCID<sub>50</sub>, P20-10-6.23TCID<sub>50</sub>). At every 10th passage, biological characterization of the Vero-adapted virus revealed that the virulence of the virus decreased with increase in the passage levels. The mean death time (MDT) of passage 1, passage 10 and passage 20 in hpi was recorded as 77.8±1.68, 81.6±0.66 and 84.0±0.57 respectively. Moreover, the intracerebral pathogenicity index (ICPI) of passage 1, passage 10 and passage 20 was recorded as 1.39, 1.27 and 1.16 respectively. The immunogenic trial of 20th passage Vero cell

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**Major Adviser: Dr. Ratul Sarmah**

adapted NDV was conducted on 21- days old broiler birds (n=30). Group I (n=10) immunized with 20th passage Vero cell adapted virus revealed significantly similar Haemagglutination inhibition (HI) and ELISA titre at day 7 (4.50±0.34, 3.88±0.34), day 14 (6.00±0.57, 5.40±0.40), day 21 (7.83±0.40, 8.76±0.36), day 28 (8.33±0.21, 9.72±0.30) and day 35 (8.00±0.25, 9.60±0.51) with group II (n=10) immunized with commercially available R2B vaccine at day 7 (4.66±0.33, 3.75±0.40), day 14 (5.66±0.42, 5.00±0.34), day 21 (8.00±0.36, 8.90±0.32), day 28 (8.17±0.40, 9.52±0.50) and day 35 (8.16±0.30, 9.41±0.57). Group III (n=10) was kept as unvaccinated control. These findings indicate that on the basis of biological characterization, the virulence of the adapted virus decreased with an increase in the passage levels. Moreover, the immunogenic potential of the Vero cell adapted virus (As/GP/18/92) in terms of humoral immune response was found to be significantly similar with commercially available R2B vaccine. Therefore, the isolate (As/GP/18/92) can be considered as a genotype-matched vaccine candidate in the future.

## **Seroprevalence and Molecular Characterization of Porcine Circovirus 2 (PCV2) in Certain Districts of Assam**

*Sabnam Ingtipi*

Pig farming is very important component in North east India. Piggery sector acts as one of the important source of livelihoods for the rural poor belonging to the lowest socio-economic strata. However, emergence of many infectious diseases has created havoc among the pig farmers. Porcine circovirus 2 (PCV 2) is an economically devastating emerging pathogen associated with a number of different syndromes and diseases in porcine species worldwide. In India vaccination against PCV2 is not practiced and at present, statistics about the prevalence of PCV2 in our country and specifically in Assam is scarce, which warrants detailed study to assess the extent of prevalence of PCV-2 in the porcine population of the NE/Assam. Therefore, realizing the importance of the above mentioned facts the present study was undertaken to study the sero-prevalence of PCV-2 in pigs in Assam, molecular detection and characterization of PCV-2 in clinical as well as tissue samples of suspected animals.

During the study a total of 520 blood samples were collected from 17 districts of Assam, out of which 295 were found positive for PCV 2 viral antibody by Indirect ELISA with a percent positivity of 56.73 %. It was observed that the prevalence of PCV 2 antibody was found to be more in unorganized sector (58.20%) as compared to the organized sector (52.30%).

For molecular detection PCR was conducted targeting the *ORF2* gene of PCV2. Out of 55 samples screened, 9 samples (16.36 %) were found to be positive and these 9 samples were further processed for isolation in PK-15 cell line. Out of the 9 tissue samples selected for isolation, only 5 samples could be successfully isolated as confirmed by PCR. Molecular characterization of five (5) isolates of Porcine Circoviruse2 (PCV2) was done by sequencing and phylogenetic analysis of ORF2 gene of PCV2. It was observed that, PCV2 isolated in the present study were showing high degree of homology (95-100 %) with PCVs reported from other parts of the world and interestingly the isolates of PCV2 of the present study were more closely related to isolates from China suggesting the source of the infection.

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**Abstract of M.Sc. thesis**

**Department: Veterinary Microbiology**

**Major Adviser: Dr. N. N. Barman**

The present study generated a base line data regarding the prevalence of PCV2 in Assam. Further extensive study is required to develop a robust statistical data of the circulating PCV2 isolates of Assam and adopt strategies regarding the control of the virus.

# **Molecular Characterization of Avipoxvirus From Domestic Ducks**

*Sumi Chungkrang*

Avipoxvirus (APV) is a slow spreading, highly contagious viral disease causing morbidity and mortality in both domesticated and free ranging birds which results in economic losses in poultry industry. APV in duck is endemic in Assam. A few studies have been conducted on APV in duck. Farmers of Assam rear duck without following much scientific management practice leading to increase the chance of APV infection in duck. Therefore, the present study was undertaken to study the prevalence in Assam, to isolate in suitable system and to characterize the isolated virus by molecular techniques. Out of 60 samples collected from the infected ducks of Assam, 57 were found to be positive for APV. Percent positivity of the samples for Avipoxvirus by PCR were found to be 95% (57/61). According to age group, highest number of positivity was recorded in 0-8 weeks (45/45) followed by 9-20 weeks (12/14). Among different age groups the highest morbidity was recorded at 0-8 weeks (85%) followed by 9-20 weeks (60.9%) and above 20 weeks (11.1%). The total morbidity 71.4% and cause specific mortality 15.0% was recorded in this study. A total of five isolates were selected for isolation in embryonated eggs, CEF/DEF and Vero cell line. Morphological changes such as oedematous thickening, swelling and typical pock lesion on CAM and characteristic CPE in cells including rounding, vacuolation, shrinking and detachment of cells were observed. CPE like rounding and detachment of cells were observed from the 2nd passage and from the 8th passage in CAM adapted isolates and field isolates respectively in Vero cell line. Isolation of APV at each passage level was confirmed by conventional PCR targeting the P4b core gene. Molecular characterization of the isolated APV was done by cloning and sequence analysis revealed the sharing of P4b gene under present study with other APVs reported from different parts of the world at nucleotide level (nt) level.

The present study concluded that APV in duck is common in Assam indicated by high number of positivity. APV could be successfully isolated in embryonated eggs, fibroblast cell and Vero cell line and demonstrated by conventional PCR. Molecular characterization study revealed that APV isolates of Assam were clustered along with other reported APV from India and other parts of the world.

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**Abstract of M.Sc. thesis**

**Department: Veterinary Microbiology**

**Major Adviser: Dr. P. Bora**

# Ectoparasites of Goat With Special Reference to Mange Mite

*Debjani Borah*

A study was conducted in and around Guwahati for a period of one year from July 2021 to June 2022 to study the prevalence of different ectoparasites in goats. Different ectoparasites in goat found to be prevalent in this area were ticks (67.32 %), lice (43.02%), flea (68.44%) and mite (14.38%). *Haemaphysalis bispinosa*, *H. hystricis*, *Rhipicephalus (Boophilus) microplus*, *Linognathus africanus*, *Damalinia (Bovicola) caprae*, *Ctenocephalides felis orientis*, *C. canis*, *C. felis felis* and *Sarcoptes scabiei* var. *caprae* were the prevalent species of ectoparasites found throughout the year. In the present study *Linognathus africanus* and *Damalinia (Bovicola) caprae* were reported for the first time in goat in Assam. Seasonal prevalence of the ectoparasites was studied in different climatic conditions of Assam namely temperature, humidity and rainfall. Prevalence of tick was found to be highest in the pre-monsoon season (March, April and May). The highest prevalence of lice, flea and mite was observed in the winter season (December, January and February). A significantly higher prevalence of tick and flea was observed in female goats than the male ones whereas prevalence of lice and mite was not dependent on the gender of the goats examined. Prevalence of ticks and mite was significantly higher in goats aged more than 6 months. Significantly higher prevalence of flea was observed in the goats below 6 months of age. Prevalence of lice was independent of age.

Doramectin (Advanto®) @1ml/50kg b.wt. showed better results in the treatment of goats naturally infested with *Sarcoptes scabiei* var. *caprae* in comparison to Ivermectin (Parid pour-on @1ml/10kg b.wt.) and Castor oil (an indigenous knowledge-based acaricide). The haemoglobin, PCV, TEC and lymphocyte levels in the treated goats were observed to have a highly significant increase ( $p < 0.01$ ) post-treatment (day 48). The TLC, neutrophil and eosinophil levels showed a highly significant decrease ( $p < 0.01$ ) and monocyte per cent were observed to have a significant decrease ( $p < 0.05$ ) after treatment (day 48) with the three acaricides. Oxidative stress parameters revealed that malondialdehyde (MDA) level was seen to be higher and the superoxide dismutase (SOD) and glutathione peroxidase (GPx) activities were seen to be lower in goats

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**Abstract of M.Sc. thesis**

**Department: Veterinary Parasitology**

**Major Adviser: Dr. Ranjeet Neog**



infested with *S. scabiei* var. *caprae* mite in comparison to their normal range of healthy goats kept as control. This implies that the goats infested with *S. scabiei* var. *caprae* were in a state of oxidative stress prior to the treatment(s) and with the progress of the treatment(s), the goats showed a significant decrease in MDA level and increase in SOD and GPx activities indicating a reduction of oxidative stress in the treated goats due to the treatment(s).

## **Forensic entomology-based post-mortem interval estimation in animals and birds**

*Souvik Sarma*

A study was conducted to estimate the Post-Mortem Interval (PMI) of carrions using the techniques for forensic entomology. A total 8 carrions/baits were allowed to attract fly species in the refugia. Larvae were collected from these carrions and allowed to develop up to adult stage in laboratory. Daily larval development in terms of larval length, ambient temperature and relative humidity was recorded. Based on the morphological characteristics of the eggs, larva, pupa and adults, 4 different fly species could be taxonomically identified which were attracted by the carrions/baits, namely, *Sarcophaga pattoni* (Senior-White, 1924), *Chrysomya megacephala* (Fabricius, 1794), *Lucilia sericata* (Meigen) and *Chrysomya rufifacies* (Macquart, 1843). Multiple Linear Regression analysis of Time (day) was done using the data on Daily development in length (mm) of larvae, ambient temperature ( $^{\circ}\text{C}$ ) and relative humidity (RH%). The  $R^2$ ,  $R^2$  adj., RMSE for each species of carrion was examined to check the reliability of estimated models which was found significantly reliable in estimation of PMI for all the carrions/baits under study. Bivariate non-linear regression of Time (day) was calculated on the length of larvae retrieved from the carrions. The  $R^2$  value for each of the carrions showed that the non-linear polynomial regression was reliable and the data from only larval length was sufficient to calculate the PMI for which a nonlinear regression equation was established for each of the species of carrion/bait whose time of death was known. In another set of observation, 4 carrions were collected whose time of death was not known. The carrions had already been frequented with carrion feeding fly species. These flies had laid their eggs on the carrions. Larvae from these carrions were incubated in laboratory under ambient temperature and relative humidity till they were adult. The daily larval development, ambient temperature and relative humidity were recorded. Two fly species i.e. *Sarcophaga pattoni* and *Chrysomya rufifacies* was found in these carrions. The regression equations which were developed in the first set of observation in which the time of death was known were used to estimate the PMI of these four carrions. The replicates were selected on the basis of similar or nearest meteorological parameters and the species of fly larva acquired from the carrions in the

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**Abstract of M.Sc. thesis**

**Department: Veterinary Parasitology**

**Major Adviser: Dr. Saidul Islam**

first set of observations. While using the equation in order to estimate the PMI of the carrions under study, the values of larval length in the regression equations was substituted by the values of larval length acquired from the carrions whose time of death was not known. Thus, the PMI was estimated for the carrion of Lesser Indian civet which was 6.182 days and 7.304 days according to larval length of two different fly species; for squirrel the PMI was estimated to be 3.864 days; for chicken and a mongrel pup the estimated PMI was 6.000 days and 2.678 days, respectively. Molecular characterization of the sample revealed that *C. megacephala* isolate from Assam had 91.19% similarity to the isolate from Singapore. Similarly, the Assam isolate of *S. pattoni* and *C. rufifacies* had maximum similarities of 98.21% and 99.57% with the isolates from Singapore and Malaysia, respectively. This was the first detailed experimental investigation on veterinary forensic entomology using bivariate nonlinear regression analysis to estimate the PMI.

## **Pathomorphological and Molecular Studies of Respiratory Mannheimiosis in Goats**

*Amdedul Islam Mazumder*

The present investigation was conducted to study the pathomorphological and molecular studies of respiratory Mannheimiosis in goats for a period of one year from March 2021 to February 2022. The materials for the present study were collected from various sources such as slaughter houses in and around Guwahati and from postmortem examinations carried out in the Department of Veterinary Pathology, College of Veterinary Science, A.A.U., Khanapara, Guwahati-22. Based on gross observation 30 lungs showing lesions of pneumonia were collected during post mortem examination. Twenty one lung samples showing pneumonic lesions were also collected from slaughter houses. For detailed bacteriological and pathological studies all of the 51 pneumonic lungs were chosen.

A total of 43 isolates of bacteria were obtained in the present study out of which seven isolates were morphologically and biochemically positive for *Mannheimia haemolytica* (16.28%). Apart from this, other bacteria isolated were *Pasteurella multocida* (23.26%), *E. coli* (20.93%), *Klebsiella* spp. (18.60%), *Staphylococcus* spp. (13.95%) and *Streptococcus* spp. (6.98%).

All the 7 isolates of *Mannheimia haemolytica* were screened for *Lkt* and *16s rRNA* gene respectively. The *Lkt* gene with amplicon size 206 bp and the *16s rRNA* gene with amplicon size 1500 bp was detected in all the 7 isolates of *Mannheimia haemolytica*. The Phylogenetic analysis of *16s rRNA* gene of *Mannheimia haemolytica* isolated from goats in the present study showed percent identity above 97 percent with other strains of *Mannheimia haemolytica* present in the NCBI Gene Bank throughout the world.

Different types of pneumonia associated with respiratory Mannheimiosis recorded during the present study were bronchophneumonia (37.25%), interstitial pneumonia (27.45%), haemorrhagic pneumonia (19.61%), suppurative pneumonia (11.76%), and fibrinous pneumonia (3.92%).

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**Abstract of M.Sc. thesis**

**Department: Veterinary Pathology**

**Major Adviser: Dr. (Mrs.) Shameem Ara Begum**

Patchy areas of consolidation in the cranioventral portion of lungs were the most commonly observed gross lesion in bronchopneumonia. Microscopically, bronchopneumonia was characterized by neutrophils and mono-nuclear cell infiltration with presence of fibrin in the bronchi, bronchiole, alveolar lumen and pleura.

Interstitial pneumonia cases were characterized by enlarged and rubbery lungs which do not collapse when the thorax is opened. The interlobular septa were distended with exudate. Microscopically, alveolar wall was thickened due to infiltration of polymorphonuclear cells and lined by cuboidal epithelial cells. Alveolar lumen was also filled with polymorphonuclear cells, macrophages and desquamated epithelial cells.

Haemorrhagic pneumonia cases revealed multifocal, patchy to diffuse areas of haemorrhage throughout the lung surface. Microscopically, there was hemorrhage within the alveoli and inter alveolar septa with leukocytic infiltration in the bronchus. The wall of the bronchus also showed the inflammatory changes. Areas of emphysema were also observed.

Gross pathological alterations observed in suppurative pneumonia were multiple focal abscess formation on lung surface. Presence of creamy suppuration could also be noticed in tracheal lumen. Microscopically, heavy infiltration of neutrophils could be seen in bronchial and alveolar lumen. In some cases necrotic mass admixed with bacterial colonies surrounded by thick connective tissue capsule were also recorded with infiltration of polymorphonuclear cells, mononuclear cells, plasma cells and macrophages.

In fibrinous pneumonia, lungs were covered with stringy net like material. Excess serous fluid was present in the pleural and peritoneal cavities. In few cases the lungs was tightly adhered to the thoracic wall due to deposition of fibrin. The interlobular septa were prominent due to accumulation of fibrin. Microscopically, fibrinous pneumonia was characterized by the presence of intra alveolar fibrin in the form of “fibrin balls” within the alveolar spaces. The traditional ‘oat cells’ and necrotic macrophages were present inside the damaged alveoli.

# **Prevalence and Pathology of Duck Pasteurellosis and Its Concurrent Infection with Duck Virus Enteritis**

*Anjali Das*

Duck Pasteurellosis is a contagious and septic bacterial disease of ducks. Duck Pasteurellosis remains as constant threat to duck farming. Among the viral diseases, duck virus enteritis is one of the major contagious and fatal disease of ducks, geese and swan. Sometimes duck Pasteurellosis and duck virus enteritis occur concurrently making high mortality of ducks. Recorded occurrence of duck Pasteurellosis and its concurrent infection with duck virus enteritis in Assam is found to be scanty in available literature. Though both the diseases are studied separately there is no detail study of both the diseases together. The present work was undertaken to study the prevalence and pathomorphological alterations of duck Pasteurellosis and its association with duck virus enteritis.

In the present study, prevalence and pathology of duck Pasteurellosis and its concurrent infection with duck virus enteritis were studied in different age group of ducks during the period of April, 2017 to December, 2019. Besides clinical and postmortem findings, laboratory diagnosis is utmost necessary for confirmation of the disease.

For the laboratory diagnosis, swab samples were collected from trachea, nasal orifice and cloaca as well as tissue samples from lungs, liver, spleen, heartblood, heart and kidneys. Out of a total 2,130 ducks from organized and unorganized farms, 500 swab samples (Tracheal swab, nasal swab and cloacal swab) and necropsy samples from 233 number of ducks were examined. The total prevalence rate of duck Pasteurellosis, duck virus enteritis and concurrent infection were recorded as 1.69%, 2.20% and 0.42% respectively on the basis of molecular diagnosis of swab samples and necropsy samples.

Occurrence of duck Pasteurellosis was found highest in ducklings (63.88%) followed by adult (22.22%) and 13.88% in growers. In case of duck virus enteritis highest occurrence was found in ducklings (53.19%) followed by adult (29.78%) and growers (17.02%). Occurrence of concurrent infection was found highest in ducklings

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(66.66%) followed by adult (22.22%) and grower (11.11%).

Clinical signs in all the three conditions were similar with huddling together, ruffled feather, fever, oculonasal discharge, greenish diarrhoea and death. Grossly, the vascular changes in all the visceral organs were invariably present in all the three conditions. Congestion, petechial to ecchymotic haemorrhages in lungs, liver, kidneys, heart, spleen and intestine were recorded in all the three conditions. Formation of pseudomembrane in oesophagus was observed in duck virus enteritis.

Microscopic lesions in all the three conditions were characterized by haemorrhage, congestion, degeneration and necrotic changes of the parenchymatous organs. Liver showed multiple areas of focal coagulative necrosis. In duck virus enteritis, intra nuclear, eosinophilic inclusion bodies with a distinct halo were observed inside the degenerated hepatocytes. In duck Pasteurellosis, cellular infiltration and serous exudates were recorded in lung samples. Congestion, mucosal thickening and necrosis were observed in tracheal mucosa. Necrosis and sloughing of intestinal villi, lymphocytic depletion in splenic follicles, glomerular atrophy in kidneys were also observed in all the three conditions. The lesions were found severe in concurrent infection.

Out of total 537 samples only 46 (18.25%) post-mortem tissue samples and 12 (4.21%) clinical samples showed positive for *Pasteurella multocida* specific PCR. Highest number of tissue samples that showed positive for PCR were lung (24%) and liver (20%) followed by spleen (15.38%) and heart blood (10%). All the 12 clinical samples that showed positive for *Pasteurella multocida* were from tracheal swabs (5.58%).

Out of total 512 samples, 58 (25.55%) post-mortem samples and 20 (7.01%) clinical samples showed positive for duck enteritis virus specific nucleic acid. Highest numbers of tissue samples that showed positive for PCR were liver (36%) and spleen (28.84%) followed by heart (20%) and kidney (12%). All the 20 clinical samples that showed positive for duck enteritis virus specific nucleic acid were from cloacal swabs (9.30%). In concurrent infection highest positive isolates were recorded in liver samples.

## **Etiopathological Studies on Bacterial Pneumonia In Goats**

*Deepjyoti Saharia*

The present investigation was conducted to study the etiopathology of bacterial pneumonia in goats in and around Guwahati. A total of 139 goat carcasses were examined, among which 62 carcasses showed pneumonia as the primary cause of death.

Pneumonic cases were screened on the basis of gross, microscopic, bacteriological and biochemical analysis. Detailed post mortem examination followed by histopathological examination was conducted. For confirmation of the etiological agent, bacteriological examination of the lung tissue samples from 62 representative cases were collected and examined. The etiology of pneumonia was then correlated with the gross pathomorphological and microscopic changes.

The maximum number of pneumonia cases was observed in the month of February, with the death of 16 goats (25.80%) exposed to the risk of pneumonia. Similarly, the highest mortality was reported in the month of monsoon and winter, where 21 goats (33.87%) died due to pneumonia each. In kids, less than 1 year age group, the mortality due to pneumonia was at its peak with a total of 35 kids (56.45%).

During the study, various types of pneumonia recorded were bronchopneumonia in 18 samples (29.03%) followed by interstitial pneumonia in 14 (22.58%), sero-fibrinous pneumonia in 12 (19.35%), haemorrhagic pneumonia in 9 (14.51%), suppurative pneumonia in 4 (6.45%) and other miscellaneous lesions in 5 samples (8.06%) respectively.

In bronchopneumonia, the surface of the apical lobes of the lungs was dark and consolidated. In some cases, distinct lines of demarcation between affected and non-affected parts were found. The microscopic lesions in bronchopneumonia were established by the accumulation of mononuclear cells in the alveolar lumen, interstitium and bronchiolar lumen, along with mild denudation of the bronchial epithelium.

In interstitial pneumonia grossly, the lungs were voluminous, and microscopically it was characterized by thickening of alveolar septa due to mononuclear cell infiltration, proliferation of type II pneumocytes and engorgement of alveolar capillaries.

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**Major Adviser: Dr. C.V. Phangcho**



In haemorrhagic pneumonia, gross examination indicated the presence of haemorrhagic patches throughout the lobes of the lungs. Microscopically, the lung parenchyma revealed diffused areas of haemorrhage with congested blood vessels.

In the case of suppurative pneumonia, the affected portions of the lungs revealed the formation of nodules of multiple abscesses filled with pus. The microscopic lesions were established by the infiltration of degenerated neutrophils, mononuclear phagocytic cells and denuded epithelial cells in the alveolar spaces along with disruption of the alveolar walls.

In sero-fibrinous pneumonia, lung parenchyma revealed focal to diffuse areas of consolidations involving the right apical lobe in most cases either alone or with cardiac and anterolateral borders of the diaphragmatic lobes. In some cases, the affected lobes were covered by a layer of fibrinous membrane. Microscopically, there was presence of intra alveolar fibrin within the alveolar spaces.

Pneumonia associated with other pathological conditions revealed various conditions like pneumo-enteritis (39.28%), pneumonia with haemonchosis (25%), pneumonia with hepatitis (17.85%), pneumonia with anaemia (10.71%) and pneumonia with septicemia (7.14%).

Out of the total 62 samples collected for microbiological examination to detect the aetiological agent, *Pasteurella multocida* was isolated from 21 samples (33.87%), *Staphylococcus spp.* from 15 (24.19%), *Escherichia coli* from 13 (20.96%), *Streptococcus spp.* from 9 (14.51%) and *Klebsiella spp.* from 5 samples (8.06%). PCR based detection revealed that a total of 12 (57.14%) isolates were positive for the *kmt1* gene of *Pasteurella multocida* isolate.

Lung tissue samples collected from 62 numbers of affected goats and 31 apparently healthy goats were used for estimation of enzyme activities of SOD (U/mg protein), Catalase (U/mg protein), ALT (IU/L), and AST (IU/L). The average SOD and catalase activity in the affected goats showed a significant decrease compared to apparently healthy goats, whereas a significant increase in average ALT and AST levels was found.

## **Pathomorphological and Molecular Detection of Avian Leukosis Virus Infection in Chicken**

*Nibedita Tamuly*

Avian Leukosis being a common neoplastic disease of the commercial poultry farm, causes significant economic losses to the farmers. The present study was undertaken to determine the status of the infection in the poultry population from 7 different locations in Kamrup district of Assam. During the period of study, twenty two (22) outbreaks of avian leucosis were recorded from seven (7) different locations of undivided Kamrup district of Assam. A total 243 numbers of post mortem was conducted from which 65 positive cases were reported on the basis of gross examination, histopathological alteration and molecular detection. The overall mortality percentage was recorded as 4.11%. Among different age groups maximum mortality was reported in adult birds above 20 weeks of age (7.36%). However few cases were also reported below 16 weeks of age. Breed/strain wise study revealed highest mortality was reported in BV-380(6.17%) followed by BV-300 (4.47%) which was further followed by Kamrupa (3.49%) and Daothigir (3.47%). Season wise occurrence of the infection was more during winter (4.86%) followed by pre-monsoon (4.11%) and post monsoon (3.68%).

Clinically, affected birds did not exhibit any typical clinical signs, however some of the affected birds showed signs like anaemia with pale comb, emaciation with decrease growth rate and productivity and osteopetrosis.

The gross pathological study gives a presumptive diagnosis of the diseases where prominent lesions were found in liver, spleen, kidney and heart. In all the cases hepatomegaly was most commonly seen. The affected liver also showed nodular, eucosis or diffuse form of lesions. Spleen, kidney and heart also showed enlargement, necrosis and the presence of nodular growth. Even though the bursal involvement could not be detected due to its rudimentary form in adult birds but in two cases the lesions in bursa was prominent.

Microscopic alterations were severe in liver, spleen, kidney, heart and lung characterized diffuse infiltration of immature lymphoid cells, causing distortion of normal parenchyma.

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**Department: Veterinary Pathology**

**Major Adviser: Dr. Biswajit Dutta**

Molecular detection by targeting gp85 *env* gene produced amplification bands at 229 bp. The phylogenetic analysis of the resultant sequences showed 99-100% homology with the endogenous forms of isolates from China, USA and South Korea.

Virus can be isolated on 6th day old embryo where replication of the virus was showed by severe hemorrhages and mortality 48-96 hours of post infection.

In field condition presence of other neoplastic diseases like Marek's disease produces similar lesions which complicates proper diagnosis of avian leucosis. In such situations differential diagnosis can be made on the basis of cell cytology, histopathology and Polymerase chain reaction. In histopathology Marek's diseases affected tissue showed infiltration of pleomorphic cells and on molecular detection positive samples produced bands at 225bp.

Myeloid form and erythroid forms were not found during the study. And the present study reveals that infective form of subgroup E of avian leucosis is circulating in the residential poultry population which might undergo mutation along with exogenous forms and create a more severe form of the disease.

## **Pathomorphology and Molecular Detection of Mycoplasma infection in Broiler Chicken**

*Risabh Sarmah*

In the present study, a total of 400 sera were tested for detection of *Mycoplasma* antibodies from 29 farms from 11 different locations of undivided Kamrup district, Assam. Out of the total samples tested, 13.25 per cent showed sero-positivity for *Mycoplasma gallisepticum* (MG) and 7.25 per cent showed sero-positivity for *Mycoplasma synoviae* (MS) by i-ELISA. Among different age groups, highest sero-positivity was recorded in age group of above 5 weeks (8.5%) and lowest sero-positivity was recorded in birds of age 3-4 weeks (0.75%) for MG. For MS, the highest sero-positivity was recorded in birds of age group of above 5 weeks (5.25%) and lowest sero-positivity was recorded from age 3-4 weeks (0.5%). Season-wise highest sero-positivity was recorded in winter (6.5%), followed by post-monsoon (4.25%), monsoon (1.75%) and pre-monsoon (0.75%) for MG. In case of MS, highest sero-positivity was recorded in post-monsoon (3%), followed by winter (2.75%), monsoon (1%) and pre-monsoon (0.5%).

During the period of study, a total of eleven (11) outbreaks of Chronic Respiratory Disease (CRD) were recorded, with a morbidity of 26.40 per cent and cause specific mortality of 34.25 per cent. Age-wise highest morbidity was seen in age group of above 5 weeks (28.93%) and lowest in birds of 3-4 weeks (23.28%). Age-wise highest mortality was recorded in the age group of 3- 4 weeks (38.80%) followed by 4- 5 weeks (34.86%) and lowest mortality was recorded in the age group of above 5 weeks (32.06%). Season-wise highest morbidity was observed in winter (31.17%) and lowest in monsoon (22.03%). Season-wise, the highest mortality was recorded in winter (37.35%) followed by pre-monsoon (33.04%), post-monsoon (32.94%) and monsoon (24.16%).

The *Mycoplasma gallisepticum* infected birds showed clinical signs like respiratory rales, coughing, sneezing and nasal discharges where the nostrils and eyes contained frothy exudates. Some of the affected birds showed difficulty in breathing, presence of mucous exudates in the oral cavity along with suborbital swelling. However, conjunctivitis and sinusitis could also be recorded in some of the isolated cases. Most of the outbreaks were recorded between 3<sup>rd</sup> and 6<sup>th</sup> week of age.

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The gross alterations were predominantly seen in the lungs, trachea and air sacs. Apart from these, mild to moderate alterations were occasionally observed in the liver and heart. In most of the cases, the tracheal lumen was filled with mucopurulent exudates. Haemorrhages and congestion could also be commonly observed. Sometimes there was accumulation of yellowish cheesy materials in the lower part of the trachea along with tracheitis. Presence of blood stained mucus in the tracheal lumen could also be observed in some cases. The lungs mostly appeared consolidated with haemorrhage and congestion. Cut surfaces revealed the presence of frothy exudates. Sometimes the lungs were covered with thick creamy to yellowish exudates. In most of the cases, the air sacs appeared cloudy and deposition of yellowish cheesy materials over the air sacs was also observed in severe cases. Generally, the liver and heart appeared to be normal. In few cases, the liver showed pale discolouration with or without fibrinous perihepatitis. In severe cases, a thick fibrinous covering was seen over the heart.

Microscopically, lesions were mostly seen in the trachea and lungs. However, other organs like liver and heart were also affected. Congestion and haemorrhage in the tracheal epithelium along with the accumulation of various inflammatory cells and fibrin could be recorded in most of the cases. Thickening of the mucosa, necrosis and hyperplasia of the glandular epithelium could also be seen. Other recorded lesions included hyperplasia of the muscularis layer of trachea and aggregation of lymphocytic mononuclear phagocytic cells in the mucosa and sub-mucosa. The lung parenchyma revealed congestion and haemorrhages with the accumulation of fibrinous and sero-fibrinous exudates. In severe cases, there was sloughing of the bronchiolar epithelium with the presence of exudates. Severe congestion and haemorrhages were also seen in the interstitium of the parabronchi with presence of different types of inflammatory cells like heterophils, lymphocytes, macrophages and plasma cells. Degeneration, necrosis and hyperplasia were also seen in the epithelium of the secondary and tertiary bronchi.

During molecular detection, *Mycoplasma gallisepticum* specific PCR targeting the *mgc2* gene produced the amplification band exactly at 185 bp.

On phylogenetic analysis, it was observed that different nucleotide sequences of partial *mgc2* gene formed two distinct clade designated as cluster 1 and 2. The phylogenetic tree depicted that the sequences obtained from Chhaygaon and Mirza were present in cluster 1 and found to be closely related with the MG isolates of other parts of India (Mumbai, Tamil Nadu, Punjab), Pakistan, South Africa, USA, etc.

During the period of study no outbreak of Infectious synovitis could be recorded on the basis of gross, microscopic and molecular detection in undivided Kamrup district, Assam.

## **Clinicopathological Study of Anemia with Special Reference to Canine Babesiosis**

*Ruby Devi Nath*

The present investigation was conducted to study clinicopathology of anemia with special reference to canine babesiosis for a period of 7 months from 1st November, 2021 to 31st May, 2022. During this period 2,905 dogs were screened and 1,213 of them were found to be anemic. A sample size of 200 was considered for a detailed study of anemia.

The present study revealed prevalence of anemia accounted 41.75 per cent. The age-wise prevalence revealed highest prevalence rate of anemia was observed in adult (50.80%) dogs. The sex wise prevalence revealed higher status of anemia in male (44.80%) dogs. Breed wise prevalence of canine anemia in the present study was found to be highest in non-descript (58.20%) breed of dogs.

In present study etiological classification of anemia revealed highest occurrence of anemia due to haemoprotozoan infection (57%) and among them highest infection was caused by *B. gibsoni* (69.20%) followed by *Ehrlichia platys* (24.50%) and *B. canis* (6.10%). Most common type of anemia was found to be microcytic normochromic and mild type in severity.

Gross lesions observed were hepatomegaly, splenomegaly and congested kidney. Histopathologically, degenerative changes in liver, lymphoid depletion in spleen and tubular degeneration with atrophied glomeruli in kidney were observed.

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**Abstract of M.Sc. thesis**

**Department: Veterinary Pathology**

**Major Adviser: Dr. Sushanta Goswami**

# **Pathomorphological and Molecular Detection of Bacterial Pathogens Associated with Porcine Pneumonia**

*Sabina Yasmin*

The present investigation was conducted to study the pathomorphological and molecular detection of bacterial pathogens associated with porcine pneumonia for a period of one year from February 2020 to March 2021, with special reference to *Streptococcus suis*. In the present study, a total of 180 pigs of either sex and different age groups from various sources, such as slaughter houses, private pig farms in and around Guwahati and from post mortem conducted in the Department of Veterinary Pathology, College of Veterinary Science, A.A.U., Khanapara, Guwahati-22 were subjected to detailed post mortem examination. The lungs with pneumonic lesions and upper respiratory tract were collected. Based on gross and histopathological examination, definitive lesions of various types of pneumonia were found in 127 (70.55%) lungs. Various types of pneumonic lesions recorded in the pig lungs during the present study were broadly classified into bronchopneumonia (32.28%), interstitial pneumonia (29.13%), haemorrhagic pneumonia (21.26%), suppurative pneumonia (11.81%) and fibrinous pneumonia (5.51%). Patchy areas of consolidation in the cranioventral portion of lungs was the most frequently observed gross lesion in bronchopneumonia. Microscopically, diffuse fibrin exudation, hemorrhage into the alveolar lumina, alveolar congestion and infiltration of cellular debris, mucus, fibrins and large number of polymorphonuclear cells in bronchi and bronchioles were noted. In the present study, *Streptococcus suis* (11), *Pasteurella multocida* (9), *E. coli* (4), *Staphylococcus* spp. (3), *Salmonella* spp. (1) and *Klebsiella* spp. (1) were isolated from bronchopneumonia cases. Interstitial pneumonia cases were characterized grossly by pale, heavy, firm and edematous lungs having elastic or rubbery consistency. Microscopically, alveolar wall was thickened and lined by cuboidal epithelial cells and infiltrated by polymorphonuclear cells. Alveolar lumen was filled with fibrinous exudate, polymorphonuclear cells, macrophages and desquamated epithelial cells. Various bacterial pathogens isolated from interstitial pneumonia cases were *Pasteurella*

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**Abstract of M.Sc. thesis**

**Department: Veterinary Pathology**

**Major Adviser: Dr. (Mrs.) Shameem Ara Begum**

*multocida* (11), *Streptococcus suis* (5), *E. coli* (5), *Staphylococcus* spp. (3) and *Salmonella* spp. (1).

Gross pathological changes observed in haemorrhagic pneumonia cases were patchy to diffuse areas of haemorrhages throughout all the lobes of the lungs along with vascular congestion. Microscopically, there was diffuse areas of haemorrhages throughout lung parenchyma associated with thickened interalveolar septa. Bronchiolar and alveolar lumina were filled with erythrocytes along with different inflammatory cells such as neutrophils, macrophages mixed with fibrin. *E. coli* (3) and *Pasteurella multocida* (2) were isolated from haemorrhagic pneumonia cases in the present study. Suppurative pneumonia cases revealed gross pathological alterations such as presence of large number of small purulent foci in the apical and cardiac lobes of the lungs. Thickened pleura and presence of grayish purulent exudates in the trachea and bronchi were also noted. Histopathological examination, revealed several suppurative foci consisting of central caseonecrotic mass along with presence of degenerated neutrophils were seen. *Streptococcus suis* (8), *Staphylococcus* spp. (7), *Pasteurella multocida* (6) and *Klebsiella* spp. (2) were isolated from suppurative pneumonia cases. In fibrinous pneumonia, grossly, all the lobes of the lungs were covered with stringy, yellowish, net like material and interlobular septa were prominent. Microscopically, eosinophilic fine thread like materials indicating the presence of fibrin were noticed in the broncho-alveolar lumen and interlobular septa. There was marked thickening of pleura due to deposition of fibrinous exudates. *Pasteurella multocida* (3), *E. coli* (3) and *Streptococcus suis* (2) were the bacterial pathogens isolated from fibrinous pneumonia cases in the present study. A total of 90 isolates of bacteria were obtained in the present study. Among the isolates, *Pasteurella multocida* (34.44%) were found to be predominant, followed by *Streptococcus suis* (28.89%) and *E. coli* (16.67%). Other bacteria isolated were *Staphylococcus* spp. (14.44%), *Klebsiella* spp. (3.33%) and *Salmonella* spp. (2.22%). Biochemically and morphologically positive twenty six (26) isolates of *Streptococcus suis* and thirty one (31) isolates of *Pasteurella multocida* were screened for *gdh* and *kmt1* gene respectively. The *gdh* gene with amplicon size 688bp was detected in seventeen (17) out of twenty six (26) isolates and the *kmt1* gene with amplicon size 460bp was detected in twenty seven (27) out of thirty one (31) isolates. The Phylogenetic analysis of *gdh* gene of *Streptococcus suis* from pigs of Assam in the present study showed percent identity above 99% with Germany, Canada and China strain of *Streptococcus suis*. Antibiotic Sensitivity Test conducted on *Streptococcus suis* in the present study revealed that majority of the isolates showed greater sensitivity to antibiotics such as amikacin (AK), chloramphenicol (CL), netilmicin (NET) and gentamicin (GEN). It has also been observed that the isolates showed high degree of resistance to antimicrobials such as ceftriaxone (CTR), amoxicillin + clavulanic acid (AMC), cotrimoxazole (COT), amoxicillin (AMX) and furazolidone (FR).



## **Etiopathology of pre-weaning mortality in Piglets with particular Emphasis on Anemia and Hypoglycemia**

*Samiran Borah*

The present investigation was conducted to study the etiopathology of pre-weaning mortality in piglets with particular emphasis on anemia and hypoglycemia to reduce the mortality of pre weaned piglets for the economic benefits of the farmers.

A total of 168 pre weaned piglets of the age group ranging from 0-42 days old were examined out of 951 live born piglets during the period of October, 2019 to September, 2021. The pre weaned piglets were collected from All India Co-ordinated Research Project/ M.S.P. on Pigs; 30 Sow Unit, College of Veterinary Science, A.A.U., Khanapara and private farms in and around Guwahati. A detailed post mortem examination was conducted in 116 pre weaned piglets, out of which 4 piglets were decomposed. A clinico-pathological examination was conducted in 52 live neonatal piglets for detection of anemia and hypoglycemia.

In this investigation, the population mortality of pre weaned piglets was determined 11.78% on the basis of total mortality out of total 951 live born piglets.

The pre weaned piglet mortality was caused by both infectious (78.58%) and non infectious causes (21.42%). The highest mortality in infectious conditions occurred due to enteritis (23.27%) and lowest due to pneumoenteritis (4.38%). In case of non infectious conditions, the highest mortality occurred in anemia (13.79%) and lowest due to traumatic injury (0.87%).

A total of twenty six piglets out of live 52 piglets were positive for anemia (50%). There was death of anemic piglets out of 26 anemic piglets where 16 piglets (30.76%) could not recover and died and 10 piglets recovered (19.23%) after administration of iron (Ferritas<sup>TM</sup> inj.). The blood picture of anemic piglets showed poikilocytosis and microcytic hypochromic erythrocytes.

A total of fifteen piglets below 1 week of age (28.84%) were positive for hypoglycemia out of 52 piglets examined. Of these, 6 piglets (11.53%) died due to

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**Abstract of M.Sc. thesis**

**Department: Veterinary Pathology**

**Major Adviser: Dr. S. M. Tamuli**

hypoglycemia and 9 piglets recovered naturally (17.30%) out of 15 hypoglycemic piglets.

There was significant increase of hematobiochemical parameters such as erythrocytes, Hb level, hematocrit value, Serum Fe level, reticulocytes and blood glucose level till 8 days of age but it was statistically insignificant upto 14 days age ( $p < 0.05$ ).

The reticulocyte count was lowered (0.2%) when it was stained by modified brilliant cresyl blue stain in anemic pre-weaned piglets.

Post mortem examination revealed various infectious and non infectious pathological conditions related to pre weaned piglet mortality. The infectious conditions of pre weaned piglet mortality were enteritis (24.11%), pneumonia (16.96%), classical swine fever (16.07%) gastroenteritis (9.82%), gastritis (7.14%) and pneumoenteritis (4.46%). Similarly, deaths due to non infectious diseases were anemia (14.28%), hypoglycemia (5.35%), hernia (0.89%) and traumatic injury (0.89%). The isolated bacteria from various pathological conditions were *Staphylococcus spp.*, *Streptococcus spp.* and *E. coli*.

## **Pathomorphological and Molecular Detection of *Riemerella anatipestifer* Infection in Duck**

*Udaya Sai Sitaram Tella*

The present investigation was conducted to study the patho-morphological and molecular detection of *Riemerella anatipestifer* infection in ducks in and around Guwahati. A total of 302 duck carcasses were examined, among which 91 carcasses showed positive for *Riemerella anatipestifer* infection as the primary cause of death.

The samples from suspected cases were screened based on gross, microscopic, bacteriological, and biochemical analyses. A detailed post-mortem examination followed by a histopathological examination was conducted. For confirmation of the etiological agent, bacteriological examination and molecular detection of the samples from representative cases were collected and examined. The maximum number of cases was observed in March, with the death of 56% exposed to the risk of *R. anatipestifer* infection. Similarly, the highest mortality was reported in the month of pre-monsoon with a record of 49.3% due to *Riemerella anatipestifer* infection. In the age group of 3-6 weeks, the mortality due to *R. anatipestifer* was at its peak with a total of 40%.

The *Riemerella*-affected ducks showed lethargy, droopiness, weight loss, greenish diarrhoea, necrotic dermatitis, respiratory signs including nasal and ocular discharge, and nervous signs with paddling of legs, tremors of the head and neck.

The gross alterations like haemorrhages and congestion of blood vessels were observed in other visceral organs like the liver, lung, heart, brain, and intestine. In the spleen, the mottling appearance was one of the most common lesions recorded. The liver showed an area of necrosis, hepatomegaly, fibrin deposition, and fibrosis were mostly seen. However, in a few cases, mucopurulent discharge in the trachea and air sacs appeared to be cloudy and thickened, and accumulation of yellowish cheesy materials over the air sacs and airsacculitis were noticed.

Most characteristic microscopic alterations like haemorrhage, congestion, mild focal to diffused areas of necrosis, and high amount of infiltration of inflammatory cells are found in all visceral organs like trachea, lung, heart, liver, intestine, brain, spleen, and kidney. The trachea and intestine show loss of mucosal epithelium were commonly

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**Department: Veterinary Pathology**

**Major Adviser: Dr. Churchis Vilee Phangcho**

noticed. However, in a few cases, fibrin deposition over the epicardium of the heart, lung parenchyma, and serosal surface of the liver along with hyperplasia of the bile duct was recorded.

On morphological examination, 115 isolates suspected of *R. anatipestifer*, were identified based on cultural characteristics and staining of culture. All the isolates produced small, smooth, circular, mucoid, glistening, and dew drop-like colonies on incubation under micro-aerophilic conditions for 24-48 hours in 5% sheep blood agar, trypticase soya agar and brain heart infusion agar.

All the morphologically identified *R. anatipestifer* isolates were subjected to molecular confirmation by PCR assay targeting *16S rRNA*, *gyrB gene*, and *RNase Z gene*. The PCR assay targeting *16S rRNA*, *gyrB gene*, and *RNase Z gene* revealed amplification of 91 (79.1%) isolates with anticipated products of 654bp, 162bp, and 546bp obtained following agarose gel electrophoresis.

Biochemically, all the 91 isolates showed positive for catalase, oxidase, and urease test whereas negative for indole test, methyl red test, Vokes-Proskauer test, citrate utilization test, nitrite reduction test, and different sugar fermentation tests such as Xylose, Mannitol, Maltose, Lactose, Sucrose, Dulcitol, Sorbitol, and Dextrose.

## **Evaluation of Anti-Inflammatory, Analgesic and Antipyretic Activity of *Nyctanthes arbor-tristis* Leaf Extract**

*Sumitra Debnath*

The present study was an attempt to evaluate the anti-inflammatory, analgesic and antipyretic activity of *Nyctanthes arbor-tristis* leaf extract. Based on indigenous technical knowledge and ethnomedical uses Four types of extracts, viz: ethanolic, hydroethanolic, aqueous and chloroform leaf extracts of *Nyctanthes arbor-tristis* were used in the present study. Mice were used as experimental animal. A total of fourteen groups four types of extracts and three different doses (250, 500 and 1000 mg/kg body weight) consisting of six mice in each group were used for pharmacological studies. For subacute toxicity study five groups (control, NAEE, NAHE, NAAE and NACE) consisting of six mice in each group were used. Tramadol hydrochloride was used as standard drug for evaluation of analgesic activity by Eddy's hot plate method and Tail clip method. Melonex was used as standard drug for evaluation of analgesic activity by Acetic acid induced writhing method and evaluation of anti-inflammatory activity by Carrageenan induced hind paw oedema method. Paracetamol was used as standard to evaluate antipyretic activity by Brewer's yeast induced pyrexia method. In subacute toxicity study mice were orally fed with four different extracts @ 500 mg/kg body weight for 21 days. Blood was collected on 0, 14<sup>th</sup> and 21<sup>st</sup> day to observe for any change in hematological parameters i.e. Haemoglobin, Total Erythrocytic Count, Total Leucocytic Count, Packed Cell Volume and biochemical parameters i.e. Alanine Transaminase Activity, Aspartate Amino Transferase Activity, Total Protein and Creatinine. On 22<sup>nd</sup> day post mortem was conducted to see any gross or histopathological changes in liver and kidney.

The ethanolic extract of *Nyctanthes arbor-tristis* leaves showed presence of steroids, alkaloids, phenolic compounds, glycosides, flavonoids, diterpenes and triterpenes The hydroethanolic extract of *Nyctanthes arbor-tristis* leaves showed presence of steroids, alkaloids, phenolic compounds, glycosides, flavonoids, tannins, diterpenes, triterpenes and saponins. The aqueous extract of *Nyctanthes arbor-tristis*

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**Department: Veterinary Pharmacology and Toxicology**

**Major Adviser: Dr. Archana Hazarika**

leaves showed presence of steroids, alkaloids, phenolic compounds, flavonoids, glycosides, diterpenes and triterpenes. The chloroform extract of *Nyctanthes arbor-tristis* leaves showed presence of steroids, phenolic compounds, flavonoids, diterpenes and triterpenes.

The ethanolic, hydroethanolic, aqueous and chloroform extracts of leaves of *Nyctanthes arbor-tristis* were subjected to acute toxicity study as per OECD guidelines 425. The absence of behavioural alteration, gross abnormality or symptoms of toxicity and mortality at 2000 mg/kg body weight indicates that the leave of the plant is safe for oral administration.

The anti-inflammatory activity of the ethanolic, hydroethanolic, aqueous and chloroform extracts of *Nyctanthes arbor-tristis* was evaluated using carrageenan induced hind paw edema method. NAEE at 250 mg/kg body weight showed significant ( $P<0.05$ ) inhibition of paw volume in the later phase of inflammation i.e. in between 5-6 hours of observation period. Whereas NAEE at 500 and 1000 mg/kg body weight showed inhibition of paw volume at 2 hours, but at 3 hours it showed maximum increase in paw volume. From 4 hours onwards upto 6 hours of observation period there was significant ( $P<0.05$ ) inhibition of paw volume. NAHE at 250, 500 and 1000 mg/kg body weight showed inhibition of paw volume at 2 hours, but at 3 hours it showed maximum increase in paw volume. From 4 hours onwards upto 6 hours of observation period there was significant ( $P<0.05$ ) inhibition of paw volume. NAAE at 250, 500 and 1000 mg/kg body weight showed inhibition of paw volume at 2 hours, but from 3 hours to upto 4 hours it showed increase in paw volume. From 5 hours there was significant ( $P<0.05$ ) inhibition of paw volume upto 6 hours of observation period. NACE at 250, 500 and 1000 mg/kg body weight also showed inhibition of paw volume at 2 hours, but at 3 hours it showed increase in paw volume. From 4 hour onwards there was significant ( $P<0.05$ ) inhibition of paw volume upto 6 hours of observation period.

All the four (ethanolic, hydroethanolic, aqueous and chloroform) extracts of *Nyctanthes arbor-tristis* at all doses produced significant narcotic analgesic activity by Eddy's Hot Plate Method and Tail Clip Method and non-narcotic analgesic activity by Acetic acid induced writhing method.

The antipyretic activity of the ethanolic, hydroethanolic, aqueous and chloroform leaf extracts of *Nyctanthes arbor-tristis* was evaluated using brewer's yeast induced pyrexia method. Leaf extracts of NAEE, NAHE, NAAE, NACE and standard drug paracetamol showed significant ( $P<0.05$ ) antipyretic activity from 1hour upto 5 hours of observation period which was maximum at 5 hours post administration of test extracts.

The present subacute toxicity study revealed no such significant changes in the hemato-biochemical parameters such as Haemoglobin, Total Erythrocytic count, Total Leucocytic count, Packed cell volume, Alanine Aminotransferase, Aspartate AminoTransferase, Total Protein and Creatinine. Although there were some insignificant changes on 21<sup>st</sup> day in haemoglobin content, Total Leucocytic Count,

Alanine Aminotransferase and Creatinine levels. Histopathology studies revealed mild degenerative changes in liver and kidney of treated group.

In conclusion, All the four leaf extracts (ethanolic, hydroethanolic, aqueous and chloroform) of *Nyctanthes arbor-tristis* has significant anti-inflammatory activity. Ethanolic, hydroethanolic, aqueous and chloroform leaf extracts of *Nyctanthes arbor-tristis* was found to possess significant narcotic analgesic activity when tested by Eddy's Hot Plate method and Tail Clip method. The four leaf extracts was also found to possess significant non-narcotic analgesic activity by Acetic acid induced writhing method. All the four extracts (ethanolic, hydroethanolic, aqueous and chloroform) of *Nyctanthes arbor-tristis* also possessed significant antipyretic activity when tested by Brewer's Yeast Induced Pyrexia method. The present study indicated that leaves of *Nyctanthes arbor-tristis* can be used as an alternative to anti-inflammatory, analgesic and antipyretic drug. However further studies are necessary to validate the toxicity effect of herbal drugs. The present study has contributed to the fact that naturally occurring herbal drugs may not be safe/non-toxic in every situation.

# **Monitoring Certain Physiobiochemical Parameters of Post Weaned Crossbred Kids Raised under Three Different Climate Resilient Housing System**

*Dhiman Patgiri*

The present experiment was conducted to study the growth and physiobiochemical performances of post-weaned (90 days) female crossbred kids (Beetal × Assam Hill Goat) kept under three different climate resilient housing system (i.e., Shed-A, Shed-B and Shed-C) from weaning (90 days) till the attainment of puberty. A total of 21 numbers of post-weaned (90 days) female crossbred kids (Beetal × Assam Hill Goat), maintained in intensive care of management and fed a uniform ration in accordance to ICAR, 2013 feeding standard were randomly divided into three groups of average equal body weight having 7 animals in each group and housed in three different housing system which differed in terms of their ventilation system, materials used, colour, ground clearance etc. Temperature, relative humidity and THI of the ambient surrounding and inside the three sheds were recorded thrice daily viz., morning, afternoon and evening hours during the experimental period and it was found that temperature and THI varied significantly among the ambient surrounding and the three Sheds with lowest temperature and THI recorded in the Shed-B i.e., having side ventilation with walls and floor made of bamboo material. The physiological parameters related to thermal stress viz., respiratory rate, pulse rate and rectal temperature were recorded at alternate days in the morning hours during the experimental period and statistical analysis revealed significant differences ( $P<0.01$ ) in those parameters with the lowest value recorded in the Shed having the lowest THI. The body weight measurement was done at fifteen days (Fortnightly) interval and statistical analysis revealed significant differences ( $P<0.01$ ) in the body weight of the animals in the different housing system and the housing system having lowest THI showed highest body weight gain ( $9.75\pm 0.24$  Kg) compared to the animals of other housing systems. Similarly, the age of attainment of puberty was attained by close monitoring of the animals for signs of puberty and statistical analysis revealed significant differences

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( $P < 0.01$ ) in the age of attainment of puberty with the lowest age ( $200.43 \pm 5.96$  Days) of attainment of puberty was found in animals reared in the system having the lowest THI value. Blood samples were collected at fifteen days (Fortnightly) interval for the analysis of certain haemato-biochemical parameters. Statistical analysis revealed non-significant differences in the Hb, RBC, Glucose and SOD concentrations. Although, there was an apparent decrease in the SOD ( $1.25 \pm 0.03$  u/g) concentration in the housing system having lowest THI value. The PCV concentration showed significant differences ( $P < 0.01$ ) among the various housing system with the minimum PCV ( $18.86 \pm 0.16$  %) value was recorded in the animals housed in the Shed having lowest THI. Analysis of variance revealed that the Cortisol, T3 and T4 concentration showed significant differences ( $P < 0.01$ ) among the animals housed in the different housing system. Thereby it can be seen that housing system having strong implication on various physiobiochemical parameters of an animal and also has the potential to ameliorate the effect of thermal stress on animal.

## **Physiological Effect of Cryoprotectants in Freezing of Embryonic Fibroblast Cells**

*Faijun Toufiki*

Fibroblast cells are the most common cells of connective tissue and form structural framework. In the present study duck embryonic fibroblast cells were developed up to third subcultures and were cryopreserved in three freezing media consisting of freezing medium 1 (10% DMSO), freezing medium 2 (0.9 M Trehalose) and freezing medium 3 (10% DMSO+ 0.09 M Trehalose in 1:1). The cells conforming the morphologically characteristics of fibroblast like typical fusiform shape, turgor vitalis cytoplasm, centrally located nuclei and flame like migration pattern were used for the experiment. The effect of cryoprotectant at equilibration and at different time of post thaw was assessed by their viability and post thaw characteristics. Trypan blue is an azo-based hydrophilic, tetra sulfonated blue acid dye which is used to determine the number of viable cells present in a cell suspension. A viable cell will have clear cytoplasm and non-viable cell will have a blue cytoplasm. The viability percentage before cryopreservation the viability of the duck fibroblast was  $90.75 \pm 0.047$ . For freezing medium 1 (10% DMSO), the viability percentage at equilibration was found to be  $89.75 \pm 0.047$  and subsequently at 7 days  $89.61 \pm 0.064$ , at 14 days  $89.30 \pm 0.035$ , at 21 days  $89.06 \pm 0.011$ , at 28 days  $89.69 \pm 0.14$ . For freezing medium 2 (0.9 M trehalose), the viability percentage at equilibration was found to be  $87.69 \pm 0.82$  subsequently at 7 days  $86.73 \pm 0.14$ , at 21 days  $86.42 \pm 0.04$ , and at 28 days  $86.00 \pm 0.06$ . The viability percentage was significantly higher ( $p < 0.05$ ) in freezing medium 3 (10% DMSO+0.9 M Trehalose in 1:1) followed by freezing medium 1 (10% DMSO) and freezing medium 2 (0.9 M trehalose). For freezing medium 3 (10% DMSO + 0.9 M Trehalose in 1:1), the viability percentage was found to be at equilibration  $90.39 \pm 0.084$  and subsequently at 7 days  $89.78 \pm 0.068$ , at 14 days  $89.78 \pm 0.068$ , at 21 days  $89.71 \pm 0.13$ , at 28 days  $89.68 \pm 0.021$  respectively. The revival of freezing media 3 (10% DMSO + 0.9 M Trehalose in 1:1) was found to be at 24 hours  $14.12 \pm 1.65$ , at 48 hours  $26.44 \pm 1.93$ , at 72 hours  $40.44 \pm 2.27$ , at 84 hours  $50.64 \pm 2.89$ , at 96 hours  $59.32 \pm 0.23$ . For freezing media 1 (10% DMSO) the confluency was found to be at 24 hours  $17.68 \pm 0.97$ , at 48 hours  $32.32 \pm 0.99$ , at 72 hours  $43.12 \pm 1.12$ , at 84 hours  $49.56 \pm 0.18$  and at 96 hours  $59.28 \pm 0.14$ .

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For freezing media 2 (0.9 M trehalose) the revivability was found to be 24 hours  $9.72\pm 0.08$ , at 48 hours  $14.84\pm 1.14$ , at 72 hours  $25.20\pm 1.20$ , at 84 hours  $44.56\pm 0.30$ , at 96 hours  $53.76\pm 0.10$ . The confluency of freezing medium 3 was significantly higher ( $p < 0.05$ ) found better than freezing medium 1 and freezing medium 2. Found that both intracellular and extracellular cryoprotectant which may favor the normal physiological process at equilibration and at thawing. NANOG, a noble pluripotent marker was found to be present in the developed fibroblast cells as well as after cryopreservation.

## Strategy for Development of Stem Cell Like Embryonic Fibroblast Cells

*Prerana Das*

Fibroblast cells are the type of cells that play an important role in the formation of connective tissue. The use of fibroblast cell is versatile, for e.g., demonstration of avian viruses, feeder cells, production of vaccines, preservation of genetic resources etc. In this present study, duck embryonic fibroblast cells were isolated, cultured, and sub-cultured up to six passages. The cells were grown in four culture media i.e., Medium 1(MEM), Medium 2(MEM+IGF-1), Medium 3 (MEM+10% FBS), Medium 4 (MEM+10% FBS+IGF-1). In serum and serum-free media the time required for the cells to attain 70% confluence in primary culture was  $84.667 \pm 0.152$  hours and  $111.867 \pm 0.161$  hours respectively. The cells grown in medium containing serum showed better results than cells grown in serum-free medium. The time taken to reach 70% confluence in 6th passage in Medium 2 and Medium 4 which are IGF-1 supplemented are  $94.583 \pm 0.217$  hours and  $62.167 \pm 0.096$  hours respectively whereas time taken in Medium 1 and Medium 3 which are IGF-1 free media are  $95.350 \pm 0.039$  hours and  $62.667 \pm 0.152$  hours respectively. Therefore, the cells grown in IGF-1 supplemented media showed significant difference compared than the rest of the culture media ( $p \leq 0.01$ ). Morphologically, the cells showed characteristic spindle shape, turgor vitalis cytoplasm, centrally located nuclei and flame-like pattern up to the sixth passage. The viability assessment was carried out in first, second, third, fourth, fifth and sixth sub-culture and the viability percentage of the cells in six different sub-cultures were  $89.843 \pm 0.108$ ,  $91.427 \pm 0.082$ ,  $91.228 \pm 0.081$ ,  $91.867 \pm 0.079$ ,  $92.231 \pm 0.073$ ,  $93.431 \pm 0.069$  in the case of Medium 1,  $90.425 \pm 0.085$ ,  $92.358 \pm 0.124$ ,  $93.692 \pm 0.084$ ,  $93.982 \pm 0.282$ ,  $94.625 \pm 0.089$ ,  $94.892 \pm 0.096$  in the case of Medium 2,  $89.145 \pm 0.263$ ,  $90.482 \pm 0.09$ ,  $91.643 \pm 0.143$ ,  $92.713 \pm 0.186$ ,  $93.460 \pm 0.079$ ,  $94.543 \pm 0.074$  in Medium 3, and  $88.597 \pm 0.132$ ,  $89.387 \pm 0.143$ ,  $90.552 \pm 0.101$ ,  $91.423 \pm 0.078$ ,  $93.077 \pm 0.140$ ,  $93.077 \pm 0.140$  in Medium 4. The viability percentage between the passages was significantly different ( $p \leq 0.01$ ). However, the viability of the cells was better from the second subculture compared to primary cultures. The pluripotency of the cells was observed by immunostaining using NANOG antibody, a pluripotent marker that is

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expressed in embryonic stem cells. It was observed that cells showed positive for NANOG at every subculture depicting their pluripotent nature.

## **Monitoring Physio-Biochemical Characteristics in Goat During Transition Period Following Selenium and Vitamin E Supplementation**

*Salima Siddika*

Twenty-four (24) healthy, adult and pregnant Crossbred goats, (Assam Hill Goat x Beetal) were taken to study the effect of Selenium and Vitamin E on Hemato-Biochemical profile, Reproductive performance and Stress during transition period. The duration of the experiment was four months (February 2022 to June 2022). The experimental animals were divided into four (4) groups, *viz.*, C, T-1, T-2 and T-3, comprising of six (6) animals in each group. Group C was fed normal basal diet without any supplementation, group T-1 was fed normal basal diet with 100 mg Vitamin E and 0.5 mg Selenium, group T-2 was fed 250 mg Vitamin E and 1.25 mg Selenium along with normal basal diet and group T-3 was fed 500 mg Vitamin E and 2.5 mg Selenium along with normal basal diet. Parameters recorded in this study were: Body Weight of the kids ; Physiological Parameters (Temperature, Pulse Rate, Respiration Rate), Hematological Parameters (Haemoglobin, PCV, TEC, TLC), Biochemical Parameters (Total Protein, Glucose, Cholesterol), Hormones ( $T_3$ ,  $T_4$ , Cortisol), Oxidative Stress Biomarker (Malondialdehyde and Super Oxide Dismutase), Liver Biomarker (Aspartate Aminotransferase and Alanine Transaminase), Kidney Biomarker (Creatinine and Blood Urea Nitrogen), Molecular stress biomarker (*HSP70*), and Temperature Humidity Index (THI).

Birth weight of the kid of the experimental group T-3 was found to be significantly ( $P < 0.05$ ) higher. Body weight gained after 4 weeks was significantly ( $P < 0.05$ ) higher for T-2 and T-3 groups. Physiological Parameters (Temperature, Pulse Rate and Respiration Rate) and Hematological Parameters (Haemoglobin, PCV, TEC and TLC) did not differ significantly ( $P > 0.05$ ) in the treatment animals, but apparent improvement was observed in Hb, TEC and PCV. Among the Biochemical Parameters, Total Protein, Glucose and Cholesterol concentration in the serum was found to be non-significant ( $P > 0.05$ ). In Hormonal Profiles  $T_3$  and  $T_4$  values showed significant ( $P < 0.05$ ) increase in T-2 and T-3 groups.

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On the contrary, in the corresponding groups Cortisol decreased significantly ( $P < 0.05$ ). Liver Biomarker (Aspartate Aminotransferase, Alanine Transaminase), and Kidney Biomarker (Creatinine, BUN) was also found to be non-significant ( $P > 0.05$ ) Oxidative Stress Biomarker, Malondialdehyde (MDA) was found to significantly ( $P < 0.05$ ) decreased with increase of SOD in T-2 and T-3 treatment groups. Molecular Stress Biomarker (*HSP70*) showed significant ( $P < 0.05$ ) decrease in T-2 and T-3 groups from 5<sup>th</sup> week and 3<sup>rd</sup> week onwards respectively. THI values (78-84.7) indicated that the experimental animals were under severe heat stress during the period of experiment.

The findings of the present study have revealed that, 1. Selenium and Vitamin E improved hematological profile (Hemoglobin, Total Erythrocyte Count, Packed Cell Volume) non significantly ( $P > 0.05$ ), while no effect was found on TEC. Also, there was no effect on Biochemical parameters (Total Protein, Glucose, Cholesterol), Liver Biomarkers (AST, ALT) and Kidney Biomarkers (BUN, Creatinine). 2. Selenium and Vitamin E at the dose rate of 2.5 mg and 500 mg respectively, significantly ( $P < 0.05$ ) increased the body weight of the newborn kids at birth and after one month of kidding. 3. Vitamin E and Selenium helps in reducing the oxidative stress by decreasing the lipid peroxidation in the body.

## **Analysis of Duck Farming Systems in Morigaon District of Assam**

*Anuj Dutta*

A survey study was conducted to analyze the duck farming systems in Morigaon district of Assam. For this, two villages from each of the six development blocks with higher duck population were selected and from each village 12 duck farmers were taken as respondents through snow-ball sampling technique. As such 12 duck farmers from 12 villages were interviewed for the purpose making the total sample size 144. Duck farmers having atleast 10 numbers of ducks of different ages and who were experienced in duck farming were considered for the present study as a duck farmer and was interviewed personally through pre-tested interview schedule by the investigator. Further participatory extension methods were deployed to elicit responses from the Key Informants and drawal of final conclusions for the study.

Duck keeping was practiced by people from all social classes, regardless of their occupation, religion or educational background. People raised ducks primarily for their eggs and meat and kept their flocks close to their dwellings, involving every member of the family in the process. Majority (50.69%) of the farmers were from middle aged (36-50 years) group. Out of the total farmers under investigation 51.38% got qualification upto 10th standard. Majority (74.30%) of the farmers were from Hindu community. About 74.00% farmers had more than 10 years of experience in duck farming.

The demographic distribution of ducks revealed the presence of eight distinctive groups of ducks viz. Pati, Graded, Khaki Campbell, White Pekin, Muscovy, Chara-Chemballi, Indian Runner and Nageswari. The majority of farmers maintained only one breed of duck and the *desi* breed Pati constituted the majority of duck population. The flock strength ranged from 15-150 numbers of ducks with a mean of 32.27 numbers. The majority (95.83%) of farmers kept a male to female sex ratio of 1:5.

The natural incubators were broody duck or hen but few farmers practised artificial incubation. Majority (99.30%) of farmers did not clean eggs and candle the hatching eggs during the process of natural incubation. About 85.00% of duck farmers hatched their duck eggs during the month of April to July (84.84%) and only few farmers performed hatching throughout the year either through natural or artificial

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**Abstract of M.Sc. thesis**

**Department: Poultry Science**

**Major Adviser: Dr. Joga Dev Mahanta**



means of hatching. According to the size of the bird, a total of 10-12 and 14-18 numbers of hatching eggs were set under each broody hen and duck, respectively. The mean hatchability percentage was recorded as 86.24% with a range of 65.00 - 95.00%.

Most of the farmers (92.36%) under study fed their duckling from second day of age onwards with raw ingredients like whole paddy grain, whole rice, broken rice, cooked rice, wheat bran and rice polish upto 4th week of age. Grower and adult ducks were reared by the farmers under scavenging or free range system. Majority (92.36%) of the farmers did not provide artificial warmth to the duckling during brooding period while few farmers (7.64%) provided artificial warmth upto 4 weeks of age. During day time duckling were confined in an open area surrounded by bamboo basket, fish trap or mosquito net where provision of drinking and feeding facilities were provided to save them from predators and wild birds. The majority (98.61%) of farmers followed free range system of rearing for adult ducks and allowed to scavenge them in the foraging field during day time. In the morning, evening and even in noon time supplementary feeds in the form of kitchen waste mixed with cooked rice and rice polish was provided. Another system of duck rearing in which a night holding pen was constructed on an elevated area amidst paddy fields, beels, ponds and other water logged areas to keep the adult ducks during night time. Few duck farmers (8.33%) adopted integrated duck cum fish farming. The major viral, bacterial and fungal diseases encountered in the surveyed area were duck plague, duck cholera, anatipestifer infection, hepatitis (aflatoxicosis) and botulism. Occasionally worm infestation was also found and mortality sometimes occurred due to predators. The mean mortality rate of 8.04% (0-20%) in ducklings, 1.55% (1-3%) in growers and 6.01% (0-10%) in adults was noticed. Majority of farmers (67.36%) did not consult veterinary doctor during the occurrence of any disease. Besides treating the ducks with common antibiotic, vitamin and mineral supplements, liver tonic, they also treated their ailing ducks with indigenous medications. None of the farmers vaccinated their ducks. The mean body weight of adult ducks recorded at 40 weeks of age for Pati, Khaki Campbell and Graded ducks was 1488.92±6.53, 1855.08±6.37 and 1519.00±14.57 g, respectively. The mean egg weight of Pati, Khaki Campbell and Graded ducks at 40th week of age was recorded as 67.04 ± 0.63, 66.42 ± 0.62 and 67.56 ± 0.69 g, respectively. The annual egg production of Pati, Khaki Campbell and Graded ducks was found to be in the range of 90-100, 240-250 and 140 – 150 per duck, respectively. The age at first egg for Pati, Khaki Campbell and Graded ducks ranged from 210-240, 150-180 and 180-200 days, respectively. Most of the farmers maintained their flock for 2-3 years of production. The farmers generally purchased duckling at day-old or at one month of age either from the local market or from their neighbours/local hatchery located in the nearby places. Most of the farmers reared ducks for household consumption and the excess eggs and meat ducks were sold through two types of marketing channel- (I) producer → consumer and (II) producer → middle man → consumer. The table eggs and live ducks were sold @ Rs. 9.00 -10.00 per egg and Rs. 450.00 – 600.00 per duck. Demand and consumption of duck meat increased many folds during winter and festive seasons like Durga puja, Kali puja, New

Year's Eve, Magh bihu and during picnic season starting from October to February. The duck meat becomes tastier due to fat deposition during the month of November to January. None of the farmers were dependent upon the financial supports from any financial agency. Occasionally, the Krishi Vigyan Kendra, Morigaon distributed improved varieties of duck to the beneficiaries interested in duck farming. Duck farming was found to be a subsidiary source of income for almost all the farmers under study.

Non-availability of vaccine was ranked first among all the constraints faced by the duck farmers followed by lack of Governmental financial assistance, lack of proper guidance in duck-rearing techniques, lack of availability of quality duckling, lack of scientific know-how, lack of availability of high yielding duck breeds, higher mortality rate, lack of access to veterinary services. The duck farmers earned an annual profit of Rs. 299.00 per duck.

## **Utilization of Chicken Whole Blood for Preparation of Chicken Nuggets**

*Konmoni Goyari*

The present study was undertaken to study the utilization of chicken whole blood for preparation of chicken nuggets and study the physico-chemical qualities, microbial and sensory properties of the developed product. The study was conducted in the Department of Poultry science, Assam Agricultural University, Khanapara, Guwahati-781022.

The entire experiment was carried out in two phases, in the first phase a total of five replicates of chicken nuggets comprising of four different formulations with different blood levels *viz.* T<sub>0</sub> (0 %), T<sub>1</sub> (11%), T<sub>2</sub> (14%) and T<sub>3</sub> (17%) were prepared with extender, binder, oil, spices, condiments and ice flakes. The prepared nuggets were sliced, packed in normal packaging (low density poly ethylene) and stored under refrigeration temperature (4°C). In the second phase the shelf life of the product was studied under normal refrigeration temperature (4°C) and quality characteristics were evaluated at 0, 3<sup>rd</sup>, 6<sup>th</sup>, 9<sup>th</sup>, 12<sup>th</sup> and 15<sup>th</sup> days of storage period.

Different parameters such as iron estimation, physico-chemical qualities, proximate composition (moisture, crude protein and fat), organoleptic quality evaluation, microbial quality, shelf-life including cost of production were studied.

The iron content (mg/100mg) significantly (P<0.01) increased in proportion to the increasing level of blood incorporation in chicken nuggets. Highest iron content was found in T<sub>3</sub> (174.51±1.86) and lowest in T<sub>0</sub> (57.83±1.06) group. The blood incorporated nuggets showed a significant (P<0.01) difference between the control and treatment groups. However no significant (P>0.05) difference was observed between T<sub>2</sub> and T<sub>3</sub> groups.

The physico-chemical studies in chicken nuggets showed no significant difference (P>0.05) between the control and treated groups in emulsion stability. However incorporation of blood replacing lean meat resulted in higher emulsion stability (ml of oil/100g emulsion) numerically in the treated nuggets groups compared to control. The pH value of the chicken nuggets increased significantly (P<0.01) among groups with incorporation of blood as well as during refrigerated storage period from 0

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to 15<sup>th</sup> day. The water activity ( $a_w$ ) of the nuggets increased significantly ( $P<0.01$ ) with increase in days of storage. The water activity ( $a_w$ ) was found to be lowest in  $T_0$  and highest in  $T_3$  group. The TBA value (mg malondialdehyde/kg) showed significant ( $P<0.05$ ) differences between  $T_3$  and other groups ( $T_0$ ,  $T_1$  and  $T_2$ ) as well as with increase in storage of days. The tyrosine value (mg/100g) was found to increase with increase incorporation of blood. However, analysis of variance revealed significant ( $P<0.05$ ) difference in tyrosine value with increase storage of days.

Proximate composition studies of nuggets revealed that the moisture percent was seen to increase with corresponding increase in the level of blood.  $T_3$  ( $66.12\pm 0.49$ ) group had highest moisture percent, followed by  $T_2$  ( $65.80\pm 0.30$ ),  $T_1$  ( $65.74\pm 0.60$ ) and  $T_0$  ( $65.66\pm 0.47$ ) group. The moisture per cent showed no significant ( $P>0.05$ ) differences among the various treatment groups. The protein per cent in the products showed significant ( $P<0.01$ ) increase in the samples with incorporation of blood and the highest value was recorded in  $T_3$  ( $20.83\pm 0.82$ ) group and lowest in  $T_0$  ( $18.61\pm 0.50$ ) group. The fat per cent of chicken nuggets incorporated with whole blood showed significant ( $P<0.05$ ) difference between the control and blood incorporated groups. The fat per cent was recorded to be highest in  $T_0$  ( $5.38\pm 0.24$ ) group which gradually decreased in  $T_1$  ( $4.99\pm 0.00$ ),  $T_2$  ( $4.82\pm 0.10$ ) and  $T_3$  ( $4.74\pm 0.04$ ) group.

On overall acceptability in sensory evaluation of chicken nuggets, the highest score (7-point hedonic scale) was seen in  $T_0$  and  $T_1$  group followed by  $T_2$  and  $T_3$  group. Progressive reduction in overall acceptability of the products was found with incorporation of blood and with increase in storage of days. The overall acceptability scores differed significantly ( $P<0.01$ ) among treatment groups.

The total plate count (log cfu/g) recorded in the study were significantly ( $P<0.01$ ) higher in all nugget samples during all storage period at refrigerated temperature. The highest total plate count (log cfu/g) was recorded in  $T_3$  (3.41 to 5.77) followed by  $T_2$  (3.38 to 5.64),  $T_1$  (3.10 to 5.11),  $T_0$  (2.92 to 4.99) from 0 to 15 days but were within the permissible level. Yeast and mould (log cfu/g) were not detected throughout the storage period. Shelf-life of the blood added nuggets products were lower as compared to control.

The cost of production of chicken nuggets decreased with increased level of blood incorporation. The highest cost of production was found in  $T_0$  (Rs. 272.42) followed by  $T_1$  (Rs. 238.80),  $T_2$  (Rs. 229.58) and  $T_3$  (Rs. 220.40) per kg respectively.

Thus it can be concluded that whole blood can successfully be used for preparation of chicken nuggets for better iron and protein content in the nuggets.

# **Effect of Dietary Supplementation of Aloe Vera (*Aloe barbadensis* M.) Leaves Powder on the Performance and Carcass Quality of Commercial Broiler Chickens**

*Manasjyoti Thakuria*

The present study was undertaken to investigate the effect of feeding Aloe vera (*Aloe barbadensis* M.) leaf powder (ALP) as natural feed additive on growth performance of commercial broiler chickens. A total of 144 day-old commercial broiler chicks (Vencobb-430Y) from a single hatch were procured. The chicks were weighed; wing banded and randomly divided into 4 groups viz. T0, T1, T2 and T3 containing 36 chicks in each group. Each group was further subdivided into 3 replicates of 12 chicks in each. The chicks were reared under deep litter system of management throughout the period following standard hygienic and uniform managemental practices. The groups (T0, T1, T2 and T3) were provided Aloe vera powder in the basal diet of broiler chicken at the level of 0.00, 0.20, 0.30 and 0.40%, respectively. Local variety of raw Aloe vera leaves were procured from Paikan market of Goalpara district of Assam. Aloe vera leaves were first washed and cleaned properly to make it free from dirt and dust. The leaves were then left overnight to dry under room temperature. On the following day, these leaves were kept in the hot air oven at 50oC for 8 hours to dry. The leaves were stirred regularly to facilitate proper drying. The dried leaves were then pulverized and stored in an air tight container to avoid contamination and spoilage for use in the proposed experiment for a period of 6 weeks. All birds under control and treatment groups were offered *ad libitum* feed and clean water throughout the experimental period of 6 weeks.

The following parameters were studied during the experimental period of 6 weeks: performance traits which included weekly feed intake and total feed consumption, weekly body weight and body weight gain, Feed Conversion Ratio (FCR), Broiler Performance Efficiency Index (BPEI), livability, economics of production; carcass traits like pre-slaughter live body weight, dressed weight, dressing percentage,

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giblet weight, giblet yield, yield of cut-up-parts and relative organ weights including lymphoid organs; haematological parameters comprising of Haemoglobin, Packed Cell Volume (PCV), total RBC count, total WBC and WBC differential count; blood biochemical parameters comprising of total serum glucose (mg/dl), superoxide dismutase (unit/mg protein), total serum cholesterol (mg/dl), total serum protein (g/dl), total albumin (g/dl) and total globulin (g/dl) count and sensory evaluation.

The highest feed consumption was recorded in T3 (3627.38 g) group followed by T2(3597.42 g), T1(3585.49 g) and T0(3543.39 g) groups, respectively. The final body weight per broiler was highest in T3 group ( $2201.16 \pm 27.77$  g) followed by T2 group ( $2158.13 \pm 27.52$  g), T1 group ( $2102.63 \pm 26.01$  g) and T0 group ( $2010.55 \pm 27.73$  g). The overall Feed Conversion Ratio (FCR) was observed as 1.80, 1.74, 1.70 and 1.68 for T0, T1, T2 and T3 groups, respectively. The T3 group showed the best FCR followed by T2, T1 and T0 groups.

The BPEI was noted to be 111.66, 120.68, 126.47 and 130.95 for the treatment groups T0, T1, T2 and T3, respectively. The T3 group showed the highest BPEI value followed by T2, T1 and T0 groups. The livability was noted to be 100 per cent in all the treatment groups. The cost of production per broiler was found to be highest in T3 (₹ 257.56)group followed by T2 (₹ 253.67), T1 (₹ 251.81)and lowest for control (₹ 246.26)group. On a similar note, the gross profit per broiler was found to be highest for T3 (₹ 28.44) group followed by T2 (₹ 25.83), T1 (₹ 21.19)and T0 (₹ 15.04) groups, respectively

All the different parameters under carcass quality traits (pre-slaughter live weight, dressed weight, dressing percentage, giblet weight and giblet yield) showed non-significant ( $P>0.05$ ) difference among the different treatment groups except for pre-slaughter live weight and dressed weight. The pre-slaughter live weight was significantly ( $P\leq 0.05$ ) higher in T3 ( $2250.20 \pm 34.34$  g) group as compared to T2 ( $2173.80 \pm 40.84$  g), T1 ( $2063.40 \pm 41.73$  g) and T0 ( $2007.20 \pm 40.46$  g) groups, respectively. Among the experimental groups of broilers, there was a significant difference ( $P<0.05$ ) in dressed weight between T3 ( $1565.46 \pm 26.81$  g) and other treatment groups. The T2 ( $1514.40 \pm 24.47$  g) and T1 ( $1405.00 \pm 28.77$  g) dressed weights were similar with each other with T0 having the lowest dressed weight ( $1386.80 \pm 25.43$  g). The per cent yield of different cut-up parts on pre-slaughter live weight basis like neck, wings, back, breast, thighs and drumsticks did not differ significantly ( $P>0.05$ ) among the different experimental groups.

The per cent weights of relative organs on pre-slaughter live weight basis of broiler chicken did not differ significantly ( $P>0.05$ ) among the different treatment groups. Among the lymphoid organs, the spleen, thymus and bursa of Fabricius showed non-significant ( $P>0.05$ ) difference in per cent weights among the different experimental groups.

The mean Haemoglobin values, mean percentage of Packed Cell Volume (PCV) values, mean total Red Blood Cells (RBC) values, mean total White Blood Cells (WBC) values and mean WBC differential count values of different treatment groups T0, T1, T2

and T3 were recorded and the analysis of variance showed non-significant ( $P>0.05$ ) difference of their values among the entire group of broiler chickens.

With the exception of total serum glucose, the Aloe vera powder supplemented groups had no significant ( $P>0.05$ ) impact on the biochemical markers. The total serum glucose level was significantly decreased in T3 ( $219.00 \pm 1.87$  mg/dl) group but the values were within normal serum glucose range. The decrease in the level of total serum glucose was similar in T2 ( $222.00 \pm 1.10$  mg/dl) and T1 ( $223.20 \pm 1.66$  mg/dl) groups with T0 ( $224.80 \pm 2.66$  mg/dl) group having the highest values among all the groups but it was within normal total serum glucose range.

The mean scores for colour, texture, juiciness and overall acceptability of broiler breast meat and drumstick of T0, T1, T2 and T3 groups were studied and it was found that there was no significant ( $P>0.05$ ) difference in these parameters of the broiler breast meat and drumstick among the different treatment groups. However, the mean scores for flavour of broiler breast meat for different treatment groups were noted and the groups T1 ( $5.40 \pm 0.13$ ) and T2 ( $5.53 \pm 0.13$ ) were significantly ( $P<0.05$ ) different in flavour as compared to groups T0 ( $4.60 \pm 0.13$ ) and T3 ( $4.73 \pm 0.18$ ). The average flavour ratings for the various treatment groups of drumstick were noted and the groups T1 ( $5.33 \pm 0.15$ ) and T2 ( $5.53 \pm 0.23$ ) significantly ( $P<0.05$ ) differed from groups T0 ( $4.53 \pm 0.16$ ) and T3 ( $4.73 \pm 0.18$ ) in terms of flavour. Because the mean overall acceptability of the drumstick and breast meat ranged from 4.66 to 5.26 on the Hedonic scale, the meat can be considered to be of good grade.

Thus, it can be suggested that AVP can be efficiently and economically used as a natural feed additive in the diet of broiler chicken at the level of 0.4% to enhance the overall performance of broiler chicken.

# **Effect of Dietary Supplementation of Marigold Flower Powder on The Productive Performance of Broiler Chickens**

*Rajsekhar Sapkota*

The present study was undertaken to evaluate the effect of feeding Marigold flower (*Tagetes erecta*) powder as a natural feed additive on the performance parameters, economics, carcass characteristics, relative organ weights, cut-up parts weights, subjective meat qualities, objective meat qualities, gut histomorphometry and humoral immunity of commercial broiler chickens.

From a single hatch, 120-day-old commercial broiler chicks (Cobb-430y) were obtained. The chicks were weighed, their wings were banded and were then randomly separated into 4 groups: C (control), T1, T2, and T3, each of which contained 30 chicks. Each group was divided into three replicates, each with ten chicks. The chicks were raised using a deep litter management method during the course for a time period of 6 weeks while adhering to hygienic, standard and uniform managerial protocols. The birds under C group were offered basal diet using common feed ingredients (ICAR,2013) with no marigold flower powder (MFP). The birds under T1, T2 and T3 groups were offered basal diet with supplementation of MFP at the level of 0.3%, 0.6% and 0.9% in the feed, respectively.

For preparation of MFP, local variety of the same was procured from the flower market of Fancy Bazaar of Guwahati city of Assam. The marigold flowers were first cleaned thoroughly with water to make it free from dirt, dust and foreign bodies and then dried in hot air oven at 50°C for 6-8 hours till crisp and warm, and then ground to a fine uniform powder in a kitchen grade mixer-grinder, and then stored hermetically in a cool, dark and dry place till use. Throughout the course of the trial, all birds in the Control and treatment groups received unlimited access to food and fresh water.

The following parameters were examined throughout the six-week trial: Performance parameters which included weekly body weight change and body weight gain, feed consumption, feed conversion ratio (FCR), economics of production and livability; carcass characteristics like pre-slaughter live body weight, de-feathered

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weight, de-feathering loss, dressed weight, dressing percentage, abdominal fat weight and abdominal fat percentage; relative organ weights such as that of liver, heart, gizzard, head and shank; relative yield of cut-up parts like breast, back, drumsticks, wings, thighs and neck; sensory evaluation on the basis of subjective parameters like colour, flavour, juiciness, texture and overall acceptability; meat quality analysis on the basis of objective parameters such as texture and shear force; gut histomorphometric characteristics, hematological parameters like hemoglobin, packed cell volume, RBC, WBC, MCV, MCH, MCHC counts; and HI antibody titers against Newcastle disease virus.

The final body weight per broiler was highest in T2 group ( $2410.83 \pm 22.06$ g) followed by T1 ( $2367.23 \pm 39.48$ g), T3 ( $2127.73 \pm 23.18$ g) and C ( $2008.73 \pm 31.24$ g) groups. The T1, T2 and T3 groups had achieved 17.84%, 20.01% and 5.92% more live body weight than the control group, respectively. There was significant ( $P < 0.01$ ) difference between the control and MFP fed groups. And amongst the latter, T1 and T2 did not differ significantly ( $P > 0.05$ ) but there was significant difference between T1, T2 and T3 group. The total feed consumption per broiler was highest in T2 group (4016.14g), followed by T1 (3984.17), T3 (3638.69 g) and lowest in C group (3475.98g). The overall FCR for the entire period of the experimental groups was found best in T2 group (1.70) followed by T1 (1.72), T3 (1.75) and C (1.77) groups.

The cost of production per broiler was found to be highest in T2 (₹ 284.50) group, followed by T1 (₹ 282.60), T3 (₹ 261.86) and C (₹ 252.00) groups. However, the highest gross profit per broiler was found in T2 (₹ 28.91) group, followed by T1 (₹ 25.14), T3 (₹ 14.74) and C (₹ 9.13) groups. All the experimental groups had 100% livability. Among the carcass quality traits, the pre-slaughter live weight (PSLW) of T2 was found to be the highest ( $2315.62 \pm 27.35$ g) followed by T1 ( $2247.62 \pm 36.23$ g) T3 ( $2000.09 \pm 24.35$ g) and C ( $1865.46 \pm 24.50$ g) groups. Similarly, the T2 group had the highest dressed weight ( $1667.26 \pm 17.79$  g) followed by T1 ( $1617.5 \pm 37.10$ g) T3 ( $1441.45 \pm 15.35$ g) and C ( $1328.64 \pm 16.85$ g) groups. T2, T1 and T3 groups had 25.48%, 21.74% and 8.49% higher dressed weights than the Control group, respectively. The T2 group had the highest abdominal fat weight ( $89.95 \pm 1.58$  g) followed by T1 ( $87.38 \pm 1.73$ g), T3 ( $73.73 \pm 0.45$ g) and C ( $62.48 \pm 1.96$ g) groups. In all these three parameters, there was significant difference ( $P < 0.01$ ) between the treatment and control groups, however, among the treatment groups, T1 and T2 did not differ significantly ( $P > 0.05$ ).

The relative per cent liver weight of T2 ( $3.15 \pm 0.0\%$ ) was found to be the highest followed by T1 ( $3.12 \pm 0.05\%$ ) T3 ( $2.92 \pm 0.05\%$ ) and C ( $2.57 \pm 0.08\%$ ) groups. Among the marigold fed groups, T2, T1, and T3 had 22.56%, 21.40%, and 13.61% higher liver weights, respectively than their Control counterpart. The MFP supplemented groups had significantly ( $P < 0.01$ ) higher liver weights than their control counterparts, but amongst the former, T1 and T2 did not differ significantly ( $P > 0.05$ ). On the other hand, relative intestinal weight of T2 ( $5.12 \pm 0.05\%$ ) was found to be the highest followed by T1 ( $4.89 \pm 0.05\%$ ), T3 ( $4.72 \pm 0.05\%$ ) and C ( $4.68 \pm 0.06\%$ ) groups. In comparison to their Control

counterpart, the marigold fed groups i.e., T2, T1, and T3 had 9.40%, 4.48%, and 4.00% higher intestinal weights. The treatment groups had significantly ( $P<0.01$ ) higher intestinal weights over the control group and amongst them they differed significantly ( $P<0.05$ ) as well.

The mean per cent yield of breast was found to be the highest in T2(24.35  $\pm$ 0.08%) followed by T1 (23.23  $\pm$ 0.18%) T3 (22.52  $\pm$ 0.05%) and C (20.25  $\pm$ 0.21%) groups. The mean per cent yield of drumsticks were found to be the highest in T2(12.75  $\pm$ 0.04 %) followed by T1 (11.38  $\pm$ 0.10%) T3 (10.81  $\pm$ 0.05%) and C (9.63  $\pm$ 0.12%) groups. The mean per cent yield of thighs were found to be the highest in T2(13.45  $\pm$ 0.04 %) followed by T1 (12.28  $\pm$ 0.11%) T3 (11.71  $\pm$ 0.03%) and C (10.46  $\pm$ 0.12%) groups. The marigold fed groups differed significantly from the control ( $P<0.01$ ) as well as amongst them ( $P<0.05$ ).

The organoleptic qualities of breast and drumstick meats were studied in terms of colour, flavour, juiciness, texture and overall acceptance by utilizing semi trained taste panelists employing Hedonic scale of 1(least) to 7(best).The mean overall acceptance scores of broiler breast and drumstick meats for different treatment groups was found to be the highest in T3 (5.89 $\pm$ 0.21 and 6.19 $\pm$ 0.21)followed byT2 (5.66 $\pm$ 0.16 and 5.97 $\pm$ 0.16), T1 (5.58 $\pm$ 0.21 and 5.59 $\pm$ 0.17) and C (5.00 $\pm$  0.23 and 5.05 $\pm$ 0.25) groups. The MFP supplemented groups had significantly ( $P<0.01$ ) higher scores of overall acceptance over the control group but did not differ significantly among them ( $P>0.05$ ).

The objective meat quality of breast meat was done using Texture Meter as well as Warner-Bratzler shear force apparatus. The hardness values (kg) of breast meat was found to be the lowest in T2 group (2910.738), preceded by T1 (3060.325), T3 (3085.681) and C (4981.010) groups. Chewiness (g) and Resilience (ratio) were found to be lowest in T3 group (589.094 and 0.111), preceded by T2 (591.11 and 0.127), T1 (868.333 and 0.137) and C (875.273 and 0.142) groups. The mean shear force values (kg) of broiler breast meat was recorded to be the highest in C group (2.50 $\pm$ 0.10) followed by T3 (2.02 $\pm$ 0.09), T1(2.00 $\pm$ 0.07) and T2 (1.80 $\pm$ 0.07) groups.

In the gut histomorphometric study, it was found that the overall duodenal villi height ( $\mu$ m)along with the number of villi was found to be highest in T2 group, followed by T1, T3 and C. The jejunal villi height was also recorded highest in T2 group followed

by T1, T3 and C. Duodenal and jejunal villi crypt ratio was recorded to be the highest in T2 group (4.07 and 12.39), followed by T1 (2.93 and 10.57), T3 (2.12 and 9.84) and C (1.02 and 8.49) groups.

All the hematological results are found to be within the standard range, indicating that feeding MFP did not evoke adverse effects in the broilers. In the HI antibody titers study against Newcastle disease virus, there was significant increase ( $P<0.001$ ) in antibody titer progressively at different days post immunization in all the groups. However, no significant difference was observed between control and any of the three MFP supplemented treatment groups in the 35 days study period, which indicated

that the dietary MFP had no significant role in modulation of antibody titer in broiler chickens.

According to the findings of the current study, MFP may be utilized costeffectively as a natural feed additive in the diet of broiler chickens at a level of 0.60 % to enhance their general performance as well as meat quality.

## **Quality Evaluation and Shelf Life Study of Chicken Meat Patty Incorporated with Chicken Blood Plasma and Mint Powder**

*Shakura Siddika Barbhuiya*

The objective of the present study was to evaluate the quality and shelf life study of chicken meat patties incorporated with chicken blood plasma (CBP) and mint powder (*Mentha spicata*). The parameters studied were physico-chemical properties, microbial count and organoleptic properties of the developed product. The study was conducted in the Department of Poultry Science in collaboration with the Department of Livestock Products Technology and Veterinary Biochemistry, C.V.Sc, Assam Agricultural University, Khanapara, Guwahati-781022. For the experiment required quantity of fresh mint leaves were procured from vegetable *mandi* and chicken blood from local market. Sodium citrate was used as an anticoagulant. Chicken blood plasma (CBP) was separated from whole blood by centrifugation and preserved in refrigeration (4°C) till use. Mint leaves were dried by exposing the leaves to 50°C for 2 hrs in a hot air oven and powdered (MP) by using Lab grinder, preserved hermetically till further use. The whole experiment was carried out in two phases. Five replicates of chicken meat patties were made in the first phase consisting of chicken blood plasma (15%) at a fixed level for making four groups at different combinations with MP as; T<sub>0</sub> (0% CBP + 0%MP), T<sub>1</sub> (15% CBP + 0%MP), T<sub>2</sub> (15% CBP+0.5% MP), T<sub>3</sub> (15% CBP+1% MP) and T<sub>4</sub> (15% CBP+1.5% MP) while preparing chicken patties blending with the emulsion of following compositions: However, the broiler meat used in T<sub>0</sub>, T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> group was 70.0, 55.0, 54.5, 54.0, and 53.5%, respectively. The meat was mixed with following ingredients, vegetable oil (10%), corn flour (5%), spice mix (1.5%), salt (1.5%), condiments (2%) and ice cube (10%). The prepared patties were sliced to its standard size, vacuum packed and stored under refrigeration temperature (4°C) till use. The shelf life of the product was studied under second phase using the parameters such as TBARS, microbiological studies and taste panel evaluation at 0, 3rd, 6th, 9th, 12th and 15th days of storage period at 4°C. The physico-chemical evaluation revealed that 15% addition of CBP increased the pH in T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> groups.

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Similar results were obtained from the emulsion stability, protein per cent, moisture content and tyrosine value where significant ( $P < 0.01$ ) increase were found in plasma incorporated group. No effect of mint addition was noticed in any of the above mentioned parameters. TBARS value recorded to be decreased significantly ( $P < 0.01$ ) among the groups and increased with progression in storage period of 15 days. Water activity found to be increased significantly ( $P < 0.01$ ) due to 15% CBP incorporation but mint addition at 0.5%, 1.0% and 1.5% level resulted in significant decrease of water activity. No effect of CBP or mint powder (0.5%, 1.0% and 1.5%) incorporation was noticed in the thickness (mm) and diameter (mm) of the product. The microbiological study revealed that total plate count ( $\log_{10} \text{cfu/g}$ ) and psychrophilic count ( $\log_{10} \text{cfu/g}$ ) significantly ( $P < 0.01$ ) increased with the incorporation of 15 % CBP in the product whereas mint addition at 0.5 %, 1.0% and 1.5% significantly ( $P < 0.05$ ) decreased the microbial count. Also microbial load increased in all groups during 15 days of storage under refrigeration (4°C). Yeast and mould counts were not found in any of the groups when evaluated at 3 days interval for 15 days. The organoleptic evaluation of chicken meat patties was carried out by using semi trained taste panelist. It involved subjective evaluation and objective evaluation.

The subjective evaluation of chicken meat patties showed the most preferred and least liked among the treatment groups. Appearance score was best recorded in T2 group and T4 was least preferred. Colour of the patties was found to be highest in T1 group and T4 received lowest score. Flavour score was recorded highest in T2 group and T4 group found to be received lowest score. Juiciness was recorded to be significantly ( $P < 0.01$ ) higher in plasma added group (T1, T2, T3 and T4). Similarly, texture was found significantly higher in T1, T2, T3 and T4. The T2 group was found most preferred among groups for overall acceptability.

The subjective study was carried out using texture analyzer and chromameter. It included texture profile (Hardness, springiness, cohesiveness, chewiness and resilience) shear force and colour profile. Texture profile was found to be significantly ( $P < 0.01$ ) increased due to incorporation of 15 % CBP and mint powder addition at 0.5 %, 1.0% and 1.5% level. The shear force was recorded to be increased among the groups. The colour profile was evaluated by measuring  $L^*$ ,  $a^*$  and  $b^*$  value. The  $L^*$  and  $b^*$  were found to be significantly ( $P < 0.01$ ) decreasing among the groups as compared to the Control group, whereas, significant increase was found in  $b^*$  value among the groups compared to the Control group. The cost of production revealed that the Control group was most dearer (Rs. 248.10) followed by T4 (Rs. 237.20), T3 (Rs. 228.50), T2 (Rs. 219.80) and T1 (Rs. 237.20). From the various above findings it could be concluded that chicken meat patties can be prepared with 15% meat replacement by chicken blood plasma incorporating mint leaf powder at three different levels. Among all options the chicken meat patties with 15% CBP and 1.0 % mint leaf powder gave the best results in terms of economy and value addition.

# **Effect of Dietary Supplementation of Curry Leaves (*Murraya koenigii*) Powder on The Performance and Histology of Certain Lymphoid Organs of Commercial Broiler Chicken**

*Sukanya Deori*

The present research work was performed to study the “Effect of dietary supplementation of curry leaves (*Murraya koenigii*) powder on the performance and histology of certain lymphoid organs of commercial broiler chicken”. The study was carried out with 144 numbers of day-old commercial broiler chicks (Cobb-400) obtained from a single hatch with uniform body weight. The weighing and wing banding of the chicks were done individually. The broiler chicks were reared in four different experimental groups viz. T0, T1, T2 and T3 having 36 birds in each group with 3 replicates of 12 birds in each group. The chicks were reared under deep litter system of rearing following standard and uniform managemental practices. The chicks under T0 (control) group was supplemented with only basal diet, whereas the chicks under T1, T2 and T3 groups were supplemented with dried Curry Leaves Powder (CLP) at the level of 0.25, 0.50 and 0.75% in the basal diet, respectively. For the preparation of dried CLP, fresh, and matured curry leaves were collected from the local villages. Then the curry leaves were sun dried for 6 to 7 days on newspaper, until they become crispy while retaining the greenish colouration. After proper drying, leaves were grinded and stored in cellophane bags for further use during the 6 weeks of experimental period. The proximate composition of curry leaf powder was analyzed and incorporated it into the basal diet of broiler chicken at the level of 0.00, 0.25, 0.50 and 0.75%, respectively.

During the six weeks of experimental period, the following parameters were studied: performance traits which included weekly feed intake and total feed consumption, weekly body weight and body weight gain, Feed Conversion Ratio (FCR), Broiler Performance Efficiency Index (BPEI) and livability and economics of production, carcass traits like pre-slaughter live weight, dressed weight, dressing percentage, giblet weight, giblet yield, yields of cut-up parts and relative organ weights,

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organoleptic properties of chicken meat, blood biochemical parameters like serum glucose and superoxide dismutase, and histological observations of lymphoid organs (spleen, thymus and bursa of Fabricius) and jejunum of intestine after the end of six weeks of age.

In the present study, the highest feed intake per broiler was recorded in the T3 group (3253.88g) and lowest in the T1 group (3014.19g). The final body weight per broiler was found to be significantly ( $P<0.05$ ) highest in the T3 group ( $1989.43\pm 43.16$ g) followed by T2 ( $1793.34\pm 34.56$ g), T0 ( $1733.76\pm 57.33$ g) and T1 ( $1653.31\pm 49.57$ g) group. During the 6th week of age, the body weight gain was significantly ( $P<0.05$ ) higher in T3 group ( $546.37\pm 27.97$ g) and lowest in the T1 ( $360.11\pm 17.48$ g) group. The overall FCR of the entire experimental period was best in the T3 group (1.67) followed by T2 (1.83), T1 (1.87) and T0 (1.90) group. Among the different treatment groups, highest BPEI was found in the T3 group (119.11) followed by T2 (97.99), T0 (91.21) and T1 (88.40) group. The per cent livability of CLP supplemented groups (T1, T2 and T3) was found to be higher (97.22) as compared to control (91.67) group.

The production cost per broiler was highest in the T3 group (2) (226.28) followed by T0 (224.90), T2 (224.48) and T1 (213.88) group, respectively. However, the recorded gross profit per broiler was highest in the T3 group (2) (28.87) followed by T2 (17.17), T1 (8.87) and T0 (8.65), respectively.

The carcass traits comprising of pre-slaughter live weight, dressed weight, dressing percentage, giblet weight and giblet yield did not differ significantly ( $P>0.05$ ) under different experimental groups. The per cent yields of cut-up parts like neck, wings, back, breast, thighs and drumsticks showed no significant ( $P>0.05$ ) differences among the different treatment groups. The per cent weights of relative organs on pre-slaughter live weight basis did not differ significantly ( $P>0.05$ ) for different experimental groups. In the present study, the blood biochemical parameters like serum glucose and superoxide dismutase (SOD) showed significant ( $P<0.05$ ) differences among the different experimental groups. The serum glucose level decreased gradually as the level of incorporation of CLP was increased. On the other hand, the SOD level increased gradually with the increased level of CLP in the basal diet.

The organoleptic evaluation of broiler chicken meat for colour, flavour, texture, juiciness and overall acceptance did not show any significant ( $P<0.05$ ) differences among the different treatment groups.

The gross, histology and ultrastructure (scanning electron photomicrograph) of lymphoid organs (spleen, thymus and bursa of Fabricius) and jejunum of intestine of T0, T1, T2 and T3 groups of broiler chicken were studied. From the histological observations of lymphoid organs and jejunum, it was found that the average length, diameter, thickness and weight of spleen, thymus and bursa of Fabricius were significantly ( $P<0.05$ ) higher in T3 group of broiler chicken along with numerous lymphocytes aggregation in these organs. The mean length of villi and diameter of crypts of the jejunum of T3 group of broiler chicken were also significantly ( $P<0.05$ ) higher as compared to the T0, T1 and T2 groups of broiler chicken. The lymphoid

follicle of jejunum of T3 group of chicken contained numerous T and B lymphocytes. This might be due to the concentration and immunogenic effect of CLP.

Hence, it can be concluded that, the CLP can be supplemented as herbal feed additives in the diet of broiler chicken at the level of 0.75% to improve the overall performance of broiler chicken with higher gross profit per broiler. The observations in the current study has established a major role in recording the anatomical norms in respect of gross, histology and ultrastructure of lymphoid organs and jejunum of intestine of broiler chickens fed with CLP at different levels.



## **Sero-Prevalence and Molecular Detection of Canine Brucellosis in Urban and Peri-Urban Areas of Guwahati**

*Malela Saikrishna Goud*

Brucellosis is an important neglected lingering zoonotic disease of increasing veterinary and public health concern particularly in developing countries which is highly underreported in India. In Assam, the abundance of non-confined free roaming dogs in peri-urban livestock farms and enormous increase in dog ownership in metropolitan city of Guwahati has become a significant threat rendering the owners vulnerable to various zoonotic diseases including canine brucellosis. The present investigation was carried out from January, 2022 to June, 2022 to collect baseline data on dog owners, study the sero-prevalence of brucellosis in dog, detect the presence of *Brucella* spp. in dogs using molecular technique and prepare canine brucellosis prevalence map in peri-urban and urban areas of Guwahati.

A total 24 locations comprising of 12 locations each for peri-urban areas viz., Sonapur Rewa NC, Mirza, Khankar Gaon, Kahikuchi, Digaru Gaon, Shanti Basti, Bonda, Gorol, Gomoria Gaon, Birkuchi, Jorabat, Hatisila, and urban areas of Guwahati viz., Khanapara, Six Mile, Hatigaon, Uzan Bazar, Zoo Road, Hengrabari, Ganeshguri, Chandmari, Beltola, Bharalumukh, Boragaon and Kahilipara were selected. From each peri-urban location 10 livestock farms having in-contact dogs and from each urban location 10 households keeping dogs were selected.

Baseline data revealed that most of the peri-urban farmers were educated up to secondary (78.34%) level and below 50 years (92.507%), having moderately clean or dirty farms (82.50%) and reared non-descript (85.00%) local or cross breed dogs which were fed on garbage and homemade food (50.83%). Majority of the farmers did not consult veterinarian and used unsafe method of waste and carcass disposal. Contrary to this, in urban areas the dog owners were highly educated, reared descript pure breed dogs, fed commercial and homemade food to dogs (93.33%), but 94.17% owners were unaware about brucellosis. Dogs were showing various symptoms of brucellosis viz., infertility (11.25%), scrotal dermatitis (2.90%), still birth (2.50%), fetal maceration

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(2.50%), fetal mummification (1.25%), fetal resorption (1.67%), vaginal discharges (12.09%), abortion (7.91%) and lymphadenopathy (5.41%) in both urban and peri-urban areas of Guwahati.

Screening of a total of 240 serum samples of dog by RBPT and further confirmation by STAT and LFA revealed the overall sero-prevalence of canine brucellosis to be 4.16%, with 2.50% sero-positivity in urban compared to 5.83% in peri-urban areas. Highest sero-prevalence of brucellosis was recorded in Sonapur Rewa NC (2.50%) of peri-urban Guwahati.

Association between sero-prevalence of canine brucellosis with respect to the feeding habit of dogs and cases of abortion in livestock were found to be very highly significant ( $P < 0.001$ ). Significant association ( $P < 0.05$ ) between sero-prevalence of canine brucellosis was recorded with respect to the educational qualification of the farmers, sex of dogs, health status of dogs, method of disposal of farm waste and hygienic status of farms.

Molecular detection of genus specific BCSP31 gene in dog blood samples indicated the presence of *Brucella* organism, which were confirmed as *Brucella abortus* by species specific AMOS, Bruce Ladder and a multiplex PCR.

GIS maps were prepared to visualize the topographic distribution of canine brucellosis in urban and peri-urban areas of Guwahati on the basis of *Brucella* sero-prevalence in dogs, which will be of immense support in future for strategic disease control at the interface of human, animal and environment.

# **Sero-Prevalence and Molecular Detection of Leptospire in Dogs of Peri-Urban Livestock Farms and Urban Households of Guwahati**

*Ritisha Saikia*

Leptospirosis is a zoonotic disease found in multiple wild and domestic species including dogs. A study on the sero-prevalence of leptospirosis in dogs of peri-urban livestock farms and urban households of Guwahati was carried out from September 2021 to August 2022. The work was envisaged to collect baseline data from respondents by interview method using a questionnaire, to detect the pathogenic leptospire with serological assay and molecular technique and to map the prevalent areas of leptospirosis in dogs in Guwahati. A total of 240 dogs were selected randomly from peri-urban livestock farms (120 dogs) and urban households (120 dogs). The study recorded higher secondary as the main level of education in both peri-urban farmers (40.00%) and urban household owners (60.00%). Majority of the dogs in peri-urban farms were non-descript (98.33%) compared with maximum of descript dogs (60.00%) in urban households. Female dogs were more common in urban households (55.83%) in contrast to maximum male dogs in peri-urban farms (71.67%). Overall, majority of the dogs aged 1-5 years in both peri-urban farms (38.34%) and urban households (44.17%). Vaccination in dogs was mostly followed by urban households (84.17%). Dogs were provided mainly tap water (56.67%) in peri-urban farms compared to with filtered water in urban households (96.67%). The study recorded peri-urban farms (50.83%) to be moderately clean. Practice of disinfection procedure in peri-urban farms recorded 28.33%. History of no abortion was recorded in peri-urban farms (67.50%) as well as in urban households (85.83%) for both livestock and dogs. Dogs from peri-urban farms (79.17%) and urban households (55.00%) were apparently healthy. Most of the farmers and dog owners were not aware of leptospirosis in both peri-urban livestock farms (96.67%) and urban households (84.17%).

Leptospirosis of dogs showed an overall 10.42% sero-prevalence in peri-urban cattle and pig farms and urban households of Guwahati. Sero-prevalence was higher in peri-urban farms (15.83%) compared to urban households (5.00%). It was recorded

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higher in farms and households where farmers and dog owners were illiterate (30.76%) with non-descript (12.65%) as well as in male dogs (12.94%) and in dogs aged up to 1 year (14.54%). Non-vaccinated dogs (18.39%) were recorded with higher sero-prevalence. Higher sero-prevalence was more in farms providing stored water (52.17%), in dirty farms (29.27%) and farms which don't follow disinfection practices (20.93%). It was recorded to be higher in livestock farms having the history of abortion (13.52%), and farmers and dog owners those were not aware (10.56%) of the disease.

The samples collected from IgG positive and negative samples from blood, which were subjected to PCR for the detection of *16S rRNA* and *Lip132* genes of *Leptospira* showed their presence (8% each).

## **Comparative Evaluation of Interlocking Nailing and Locking Compression Plating Vis-À-Vis Management of Long Bone Fractures in Canine**

*Anjali C J*

A total of 716 orthopedic cases were presented to the Department of Surgery and Radiology and Veterinary Clinical Complex, College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati-22, from 1<sup>st</sup> November, 2021 to 31<sup>st</sup> July, 2022. Among these, 484 cases showed the signs of lameness and were confirmed as fractures. The highest incidence was reported in canine (86.16%) followed by feline (5.37%) and caprine (4.75%). Dogs less than one year of age were recorded for highest incidence of fractures. Non-descript dogs (84.65%) were most commonly affected by fractures followed by German Spitz (9.11%) and Labrador retriever (2.88). Femur bones (35.25%) as well as transverse type fractures (58.41%) were documented with highest incidence and male dogs (60.02%) were mostly affected. Automobile accident was the major cause (40.65%) of fractures in the present study.

Twelve clinical cases of diaphyseal fractures were divided into two groups viz. Group A and Group B which were subjected to Interlocking Nailing and Locking Compression Plating respectively. Lameness subsided earlier in Group B compared to Group A and by 60<sup>th</sup> day, both Groups had desired outcomes with regard to Lameness scores. Functional outcome was excellent by 45<sup>th</sup> day in Group B (83.33%). However both groups achieved excellent functional outcome by 60<sup>th</sup> day. Complete weight bearing was observed by 7<sup>th</sup> day in Group B (16.67%) compared to 30<sup>th</sup> day in Group A (16.67%).

Postoperative radiographs revealed satisfactory results in terms of alignment, apposition, angulation, apparatus, activity and architecture (6 'A's) in Group A (83.33%) and Group B (100%) throughout the observation period. Mild angulation was observed in Group A (16.67%) due to displaced fracture fragments. In both the groups the apparatus did not fatigue and secondary union with bridging of the fracture gap by callous formation was observed.

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The haematological parameters viz. Hb, TEC, PCV and ESR showed highly significant difference ( $P < 0.01$ ) whereas TLC showed significant difference ( $P < 0.05$ ) between the groups. The biochemical parameters viz. ALP and CK varied significantly between the groups whereas Ca, P, blood glucose and total protein showed non-significant difference ( $P > 0.05$ ). However, the haemato-biochemical parameters fluctuated within the physiological limits.

Complications in terms of seroma formation in Group A and delayed healing in Group B were observed which resolved on appropriate treatment.

## **Evaluation of Xenogenic Acellular Pericardium Matrix of Caprine and Porcine Origin for Abdominal Wall Reconstruction in Rabbit**

*Anjali Padhan*

The present study was carried out with the aim of evaluating the efficacy of xenogenic acellular caprine and porcine pericardium in surgical reconstruction experimentally created full thickness abdominal wall defect in rabbits (*Oryctolagus cuniculus*).

The experiment was conducted in eighteen (18) numbers of adult healthy rabbits of either sex maintained under ideal and same managerial condition. The animals were randomly divided into three groups, i.e. Group A, Group B and Group C consisting of six (6) animals in each. Full thickness abdominal wall defect of 2×2 sq. cm size was created on the lateral abdominal wall in all the animals and was repaired with acellular caprine pericardium, porcine pericardium and autologous tissue in group A, group B and group C respectively. Prior to surgical procedure, caprine and porcine pericardium were decellularised using sodium deoxycholate.

Caprine pericardium was decellularised with 2% sodium deoxycholate treatment for 36 hours and porcine pericardium was decellularised with 1.5% sodium deoxycholate for 48 hours under constant agitation in an orbital shaker at 180 rpm at 350C without disturbing the microscopic architecture of the tissue.

Clinical parameters were checked on 0, 3rd, 5th, 7th and 10th post operative days. Post operative haemato-biochemical changes were recorded on 0, 10th, 20th and 30th days of operation. The wounds were reopened on 10th, 20th and 30th day for macroscopic and histopathological examination of the implanted matrix and surrounding host tissue.

Clinical parameters were significantly increased in all groups on 3rd post operative days and decreased subsequently. Moderate degree of swelling, exudation, pain and warmth was there in all the groups in all the groups on 3rd day of operation which were more pronounced in xenograft groups as compared to autograft group.

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There was non-significant variation of haematological parameters within physiological limit in all the groups with slight variation among the groups. Serum ALP and serum total protein was increased significantly on day 10 in group A and group B and comparatively less significantly in group C. There was uniform and remarkable increase in random blood glucose in all the groups on day 10 of operation.

Mild to moderate visceral adhesion was recorded on 10th post-operative day in group A and group B which resolved automatically by the end of the experiment. On gross evaluation the host tissue proliferation was encouraging in all the groups however the in control group was fastest followed by group A and group B. Histopathological examination showed remarkable cellular infiltration in all the groups till last day of observation which was highest in group A. Angiogenesis and fibrogenesis were maximum and best visible from 10th day in group A.



# **Effect of Jackfruit (*Artocarpus heterophyllus*) Sap and Chitosan Derived Biosealant on Wound Management**

*Banashree Gogoi*

The present study was carried out in the Department of Vety. Surgery and Radiology, College of Veterinary Science, AAU, Khanapara, Guwahati-22 for a period of 1 year w.e.f. 1<sup>st</sup> October, 2020 to 30<sup>th</sup> September, 2021. The objective of the present research work was to generate a novel biosealant derived from Chitosan-Jackfruit for wound management. The study explores the primary selection of suitable concentrations of Chitosan and Jackfruit to prepare a biosealant based on physicochemical and antimicrobial properties for its clinical application. The physicochemical and antimicrobial properties of prepared biosealant showed promising outcomes with 1:2 concentrations of the Chitosan and Jackfruit which was mild acidic in pH, had viable shear strength, good storage modulus (viscosity) and antimicrobial properties.

Eighteen clinically healthy adult rabbits of either sex weighing about 2 kg body weight were used in the study. The animals were randomly divided into three groups viz. Group A (control), Group B (commercial glue) and Group C (Chitosan-Jackfruit derived biosealant) consisting of six animals each. A 6cm longitudinal full- thickness incision was created under standard surgical and anaesthetic protocol. Physiological, haematological and biochemical parameters were observed and recorded on days 0, 3<sup>rd</sup>, 7<sup>th</sup>, 14<sup>th</sup> and 21<sup>st</sup> of treatment. Grossly the wound healing was evaluated on days 0, 3<sup>rd</sup>, 7<sup>th</sup> and 14<sup>th</sup> of treatment and histopathological findings were also recorded days 7<sup>th</sup>, 14<sup>th</sup> and 21<sup>st</sup> post treatment. Physiological parameters were non-significantly increased on days 3<sup>rd</sup> and decreased subsequently with time. TEC did not show any significant variation among the groups. On days 3<sup>rd</sup>, significant increase of TLC, Neutrophil, Lymphocyte were recorded in Group A whereas, it was non significant in Groups B and C. Monocyte and eosinophil were non-significantly increased amongst the groups on day 3<sup>rd</sup>. Biochemical parameters, showed decreased in total protein and albumin level on day 3<sup>rd</sup> amongst the all the groups which later returned towards the base value. Alkaline phosphatase values was non-significantly increased upto days 14<sup>th</sup> in Group A whereas,

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it was decreased in Groups B and C. ALT and creatinine values were non significantly varied amongst the groups at different time intervals. Grossly, the wound healing was complete in groups on days 14<sup>th</sup>, whereas, it took 21 days in group A. The histopathological observation in terms of keratinisation and reorganization of collagen fibers further suggest better healing in Group C followed by Groups B and A respectively.

# **Ultrasound Guided Epidural Analgesia for Perioperative Pain Management in Dogs Undergoing Ovariohysterectomy Operation**

*Bindiya Mahanta*

The current study aimed at assessing the efficacy of Morphine and Buprenorphine as perioperative analgesics administered epidurally via a US guided lumbosacral approach in bitches undergoing elective ovariohysterectomy. Eighteen healthy female Pariah dogs of 1-4 years of age were selected that presented to the Department of Veterinary Surgery and Radiology and Veterinary Clinical Complex, College of Veterinary Science, Khanapara, Guwahati.

The animals were randomly divided into 3 groups viz. Group A, Group B, Group C with 6 animals in each group. The animals of Group A and Group B were administered Morphine @ 0.1mg/kg b.wt and Buprenorphine @4µg /kg b.wt single dose epidurally under ultrasonographic guidance before the start of the operation. The animals of Group C were kept as control for the study without any analgesic till the end of observation period.

Ultrasonographic visualization of epidural space was done by using the ultrasound probe in sagittal position. The lumbosacral intervertebral space could be accurately identified using ultrasonography. Successful deposition of analgesic into the epidural space was possible in animals of different body conditions.

The physiological parameters were recorded at 0min, 15mins, 30mins, 45mins, 60mins, 75mins, 90mins and 120mins post epidural administration. The heart rate, respiration rate, rectal temperature and mean arterial pressure had significant variation ( $p<0.01$ ) between the groups whereas oxygen concentration expressed significant variation between time intervals. All physiological parameters were found to be within physiological reference range in the study.

The assessment of pain was done by using Glasgow Composite Measure Pain Scale-Short Form (CMPS-SF). The pain assessment was done preoperatively and postoperatively at 0 min, 1 hour, 3 hours, 6 hours, 12 hours and 24 hours. The CMPS-SF scores showed a significant ( $p<0.01$ ) increase from baseline scores in the post operative

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period in all the groups at 3 hours postoperatively which gradually declined towards the end of the observation period. The animals in treatment groups had significantly lower pain scores postoperatively than the animals in the control group.

The haematological and biochemical parameters were studied preoperatively and postoperatively at 0 min, 3 hours, 6 hours, 12 hours and 24 hours. Haemoglobin and packed cell volume varied non-significantly between different groups but changed significantly between time intervals. Total erythrocyte count increased significantly 12 hours post-operatively. Blood glucose and plasma cortisol concentration varied significantly ( $p < 0.01$ ) at 3 hours post operatively in all groups. The blood glucose levels of Group A and Group B were lower compared to Group C. The cortisol levels of Group B and Group C were comparable in the initial post-operative phase which declined gradually towards the end. The blood glucose levels expressed an increasing trend while the cortisol levels presented a decreasing trend towards the end of the study period in Group C. Alkaline Phosphatase levels expressed non-significant variation in the observation period in all groups.

From the study it could be concluded that, ultrasonographic detection aided in identification of lumbosacral epidural space and deposition of analgesics which helped produce long lasting analgesia with Morphine providing better analgesia in the initial post-operative phase, which was comparable to buprenorphine for providing long lasting analgesia.

# **The Efficacy of Pectin-Honey Hydrogel and Olive Oil-Vitamin E Preparation in Prevention of Post-Operative Intraoperative Adhesions in Rabbits**

*Fulmoni Kalita*

The present study was conducted to investigate the efficacy and comparative evaluation of Pectin-Honey Hydrogel and Olive oil-vitamin E preparation in prevention of experimentally created post-operative intraoperative adhesions in rabbits (*Oryctolagus cuniculus*).

The experiment was conducted in eighteen (18) numbers of adult healthy rabbits of either sex weighing 1.0-2.0 kg and maintained under same managerial and environmental condition. The animals were randomly divided into three groups, i.e. Group A, Group B and Group C consisting of six (6) animals in each. Pectin-Honey Hydrogel and Olive oil-vitamin E were prepared by using methods described by Giusto *et al.* (2016) and Portilla *et al.* (2004) respectively. Standardized caecal/peritoneal abrasion (Giusto *et al.*, 2017) was created following caudal midline laparotomy under Xylazine and Ketamine anaesthesia in each animal. Before closing the laparotomy wound, all the animals of Group A, Group B and Group C were treated with intraoperative application of normal saline, Pectin-Honey Hydrogel and Olive oil-vitamin E preparation respectively.

Clinical parameters were checked on 0 (before surgery), 2<sup>nd</sup>, 4<sup>th</sup>, 6<sup>th</sup>, 8<sup>th</sup> and 10<sup>th</sup> post operative days. Post operative haematological changes were recorded on 0<sup>th</sup> (before surgery), 5<sup>th</sup>, 10<sup>th</sup>, 15<sup>th</sup> and 20<sup>th</sup> day of operation. Peritoneal fluid was collected on 0<sup>th</sup>, 10<sup>th</sup>, 20<sup>th</sup> and 30<sup>th</sup> post-operative days for evaluation of biochemical parameters. The wounds were reopened on 10<sup>th</sup>, 20<sup>th</sup> and 30<sup>th</sup> day for macroscopic assessment of adhesions and histopathological examination.

Clinical parameters were found to be significantly elevated on 2<sup>nd</sup> post-surgical day in all the animals followed by returning to normalcy in subsequent observation; however, elevation was non-significant in case of rectal temperature. The changes in all the groups were within the physiological limit.

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There were initial haematological changes following surgical defects in all the groups with slight variation among the groups. Post-surgical elevation of total protein concentration of peritoneal fluid was significantly higher in Group A followed by Group C and Group B. Significantly lower catalase activity of peritoneal fluid was found in Group B post-surgically.

Macroscopic peritoneal and visceral adhesion score was recorded highest in Group A and lowest in Group B. Histopathological view of tissue sample revealed more and long lasting inflammatory reaction in Group A, followed by Group C and Group B respectively.

## **Effects of Certain Anaesthetic Combinations in Goat**

*Gyandeep Choudhury*

Fifteen clinical cases of goats (apparently healthy) of either sex and having body weight of 8-20 kg were divided into three groups consisting of five animals in each group. The goats in group I received (midazolam @ 0.4 mg/kg and ketamine @ 4 mg/kg body weight i.m); goats in group II received (tiletamine-zolazepam @ 3 mg/ kg body weight i.m) while goats in group III received (medetomidine @ 20 µg/kg and ketamine 5 mg/kg body weight i.m).

Induction time of 3.2±0.58, 3.8±0.32 and 5.12±0.15 minutes; duration of anaesthesia of 21.2±1.71, 25.4±2.14 and 110±5.14 minutes and recovery time of 44.80±2.35, 60±3.32 and 123.40±4.63 minutes were recorded in group I,II and III respectively. Cessation of palpebral and pupillary reflex alongwith downward rotation of the eyeball was observed in the animals of all the three groups. Muscle relaxation and analgesia was found to be moderate in group I, poor in group II and excellent in group III. The animals in all the three groups exhibited mild to moderate salivation. During recovery, the animals in group I exhibited tympany and shivering while animals in group III exhibited mild tympany with urination.

Significant (p<0.01) change in heart rate, respiration rate, rectal temperature, tidal volume, minute volume, MAP and SpO<sub>2</sub> were recorded in all the three groups. Significant (p<0.01) decrease was recorded in the haematological parameters,i.e, Hb, PCV and TEC. The biochemical parameters, i.e, GGT, blood glucose, blood creatinine and total protein also recorded significant ( p<0.05) change in the animals of all the three groups. Cortisol levels exhibited a significant (p<0.01) increase.

All the three combinations exhibited transient changes in the physiological, haematological, biochemical and stress hormone parameters and hence are suitable for clinical use in goats. The combinations, midazolam-ketamine and tiletamine-zolazepam are suitable for short surgical procedures like castration while the combination medetomidine-ketamine is more suited for surgical procedures of longer duration.

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**Department: Veterinary Surgery and Radiology**

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# **Investigation of Ocular Maladies and Their Therapeutic Management in Veterinary Patients**

*Ifikar Islam*

Animal well-being and quality of life are affected by different kinds of disease conditions, among which one of the most important affections is ocular maladies. In the present scenario, scientific studies on ocular diseases in veterinary patients and their therapeutic management in our region is not adequate. Therefore, the present study was undertaken to fill up the void of information. The study was undertaken at six different establishments, segregating the survey work into a retrospective survey and research period survey as well as therapeutic management of the presented cases.

183499 cases were surveyed for the retrospective period of 5 years (31 March 2015-31 March 2020), out of which 843 (0.46%) were ocular disorders. 8784 cases were surveyed for the research period of 20 months (01 April 2020-30 November 2021), out of which 198 (2.25%) were ocular affections. In the retrospective study, the highest prevalence (5.15%) was observed at VCCL and the lowest prevalence (0.049%) at SVHNL. The highest incidence (4.52%) was recorded at VCCL and the lowest incidence (1.83%) at TVCC. High prevalence and incidence were noted in canine species at DSR and TVCC. High prevalence and incidence were recorded in caprine and bovine species at VCCL. High prevalence was observed for canines at SVHC and bovines at SVHNL. High prevalence and incidence of ocular affections were recorded for adult animals at all research establishments. High prevalence and incidence were observed in the Local/Mongrel breed of canines at DSR and TVCC. High prevalence and incidence were observed in the Assam hill goat and Lakhimi breed of bovine species at VCCL and Assam hill goat at GRS. High prevalence was noted for the Local/Mongrel breed of canines at SVHC and the Lakhimi breed of bovines at SVHNL. High prevalence and incidence of Cherry eye were observed in canines at DSR; conjunctivitis in canines at TVCC and SVHC. High prevalence and incidence of corneal opacity were recorded in caprine and bovine species at VCCL and corneal opacity in caprine at GRS. High prevalence of conjunctivitis was observed in bovines at SVHNL. High prevalence and incidence of ocular affections were recorded in males of canines at DSR, TVCC and SVHC. High prevalence and incidence of ocular affections

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**Department: Veterinary Surgery and Radiology**

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were noted for females of caprine and bovine species in VCCL and females of caprine at GRS. High prevalence was observed in bovine females at SVHNL. High prevalence and incidence of ocular affections were recorded during summer, monsoon and post-monsoon seasons at all research establishments. During both periods, pet animals constituted the most affected animals surveyed at DSR, TVCC and SVHC. Farm animals constituted the most affected animals surveyed at VCCL and SVHNL. Therapeutically, both surgical and medicinal treatment methods were found to be effective depending on the nature of the presented cases. Haematological studies revealed no significant difference in haemoglobin (Hb), TLC, TEC, lymphocyte (Lym), monocyte (Mon) and granulocytes (Gra) between the normal and affected animals in all of the three species. However, biochemical studies (oxidative stress) revealed significant differences for all the parameters in all three species.

The present research work represents a small fraction of the vast arena of veterinary ophthalmology. The results and findings recorded leave a trail of possible connecting dots with earlier research, which was lacking earlier. The pile of data extracted in the present research work may be considered as the base work in its field which might open future research opportunities.

# **Comparative Study of Surgical Affections of Lakhimi and Cross-Bred Cattle of Assam With their Therapeutic Management**

*Milton Engti*

The present investigation was conducted for comparative study of various surgical affections in Lakhimi and cross-bred cattle of Assam along with their therapeutic management. A total of 3137 cattle were surveyed during the period from (1<sup>st</sup> march 2019 to 30<sup>th</sup> November 2020), out of which 683 (21.77%) cattle were found to be affected with various surgical affections. During the survey Cross-bred cattle (21.81%) was found to be more affected with surgical affections as compared with Lakhimi cattle (20.88%). Maximum incidence of surgical affections was observed in summer season (64.12%) followed by winter (35.87%). Highest incidences of surgical affections were recorded in hoof affections (59%), which were followed by wounds (13.32%), bursitis (8.49%), fracture (3.80%), myiasis (3.36%), horn affections (3.07%), abscess (1.90%), umbilical hernia (1.75%), tail affections (1.46%), corneal opacity (1.02%), knuckling (0.87%), upward fixation of patella (0.58%), atresia ani (0.43%), corneal dermoid (0.43%), tumours (0.29%) and meningocoele (0.14%) respectively. Highest incidence of surgical affections was seen in the age group of 3-6 years (40.84%), followed by 6 and above years (30.30%), 1-3 years (19.91%) and 0-1 years (8.93%). Haematological investigations showed that the mean values of Hb, TEC, TLC and PCV of affected animals have decreased insignificantly as compared to healthy animals. The mean values of Neutrophil and Basophil percentages in affected animals were increased insignificantly as compared to healthy animals. The mean values of Lymphocyte and Monocyte percentage of the affected animals were decreased insignificantly as compared to the healthy animals. The mean values of Eosinophil percentage of the affected animals was increased significantly as compared to the mean values of the healthy animals. Biochemical tests revealed the mean values of serum Creatinine, Creatine Kinase and Phosphorus of the affected animals were increased insignificantly as compared to the mean value of the healthy animals. The mean value of serum Aspartate Aminotransferase (AST) in affected animals showed significant increase and Calcium in affected animals showed significant fall as compared to the mean values of the healthy animals.

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**Abstract of M.Sc. thesis**

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**Major Adviser: Dr. Kushal Konwar Sarma**

## Dental Affections and Their Management in Dogs

*Pinku Talukdar*

A total of 143 dental affections were recorded with incidence rate of 6.45% among the cases presented to Department of Veterinary Surgery and Radiology and Veterinary Clinical Complex, College of Veterinary Science, AAU, Guwahati-781022 over a period of one year w.e.f. 28<sup>th</sup> February 2020 to 1<sup>st</sup> March 2021. The highest incidence was recorded in males and in German spitz breed within an age group of 5 to 7 years. The common affection recorded was dental tartar with gingivitis and mostly 4<sup>th</sup> maxillary premolar teeth were involved. Dietary involvement showed disease affinity towards mixed homemade diet. Concurrent diseases occupied 33.56% involvement with dental affections moreover, majority of the dogs (90.21%) were deprived from oral health practices.

The common lesions for various dental affections were recorded in the form of inflamed gingiva, bleeding gum and light to heavy tartar deposition etc. The alkaline nature of salivary pH was found ideal for the diseases incidence with mean salivary pH of  $8.08 \pm 0.245$ . The periodontal score index revealed high score of stage III (41.66%) for periodontal diseases and calculus score revealed high score of II (48.95%) for dental tartar with the composition of 91.66% calcium on tartar analysis. Dental radiography provided good diagnostic tool for detecting the abnormalities of various forms of periodontal diseases and all the tooth associated structures were easily evaluated for presence of diseases. This study revealed no significant changes ( $P > 0.05$ ) in haematological and biochemical parameters. However, few parameters showed high level on 0 day indicating local or systemic dysfunction. Salivary enzymes like Creatine kinase, Serum glutamate oxaloacetate transaminase and Lactate dehydrogenase were proven to be good biomarkers for periodontal diseases as their levels were higher than normal range. Oral cavity harbored pathogens like *Staphylococcus* spp. as predominant genus which showed sensitivity for Amoxicillin drugs. Dental scaling along with polishing was effective in long term management of dental tartar and also acted as a preventive therapy in periodontal diseases. Specific antibiotics and metronidazole oral gel along with use of anti tartar sticks were some of the additional managerial practices which gave satisfactory results. Although, in advance stages of periodontal disease tooth extraction brought good outcome. Dental tumours appear mostly in benign forms which were effectively managed with surgical excision and electrocautery.

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**Abstract of M.Sc. thesis**

**Department: Veterinary Surgery and Radiology**

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## **Diagnosis, Treatment and Rehabilitation of Coxofemoral Joint Affections in Dogs**

*Pracheer Budhwar*

The present study was undertaken to diagnose, treat and manage the affections of coxofemoral joints in dogs. A total of 2214 cases of dogs were presented in the Department of Veterinary Surgery and Radiology and Veterinary Clinical Complex (Surgery Unit), College of Veterinary Science, A.A.U., Khanapara during the period from 1<sup>st</sup> August 2019 to 31<sup>st</sup> July, 2020. Total number of dogs with coxofemoral joint affections was 24 (1.08%). Age of the dogs affected with coxofemoral joint affections varied from 1 month old to 11 years of age. Among seven breeds of dogs presented, the Labrador was the highest affected with hip dysplasia and osteoarthritis/ degenerative joint disease (DJD) and Mongrel dogs were most affected with trauma. Hip joint affections were recorded in 16 males and 8 females. Affections of coxofemoral joints were recorded and classified as developmental, acquired and traumatic, based upon origin/ etiology. Incidence of all three types were equal.

Sixteen out of twenty-four cases turned up for clinical examination and treatment. Clinical assessment included physical, orthopedic and neurological examinations before and after treatment. Radiographic evaluation and haemato-biochemical estimation of Hb, TEC, TLC, ESR, PCV, serum ALP, serum calcium and serum phosphorus were recorded before and after rendering the treatment. The haemato-biochemical parameters had no significant alterations before and after the treatment.

Treatment of the diagnosed cases included conservative and rehabilitation therapy and surgical treatment for the cases necessary.

Following standard anesthetic protocol, surgical procedures followed were femoral head (and neck) ostectomy (FHO) in cases of Canine Hip Dysplasia followed by Degenerative Joint Disease (DJD) and cross-sectional pinning with Kirschner wire in femoral head or neck fracture (epiphyseal/ capital).

Medicinal treatment alone was not effective in alleviating the painful condition in affected cases. Post-surgical examination turned out to be satisfactory with normal radiographic findings. Animals were not reluctant to bear weight on the hind limbs and had almost normal gait without any symptoms of pain.

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**Major Adviser: Dr. Dwijen Kalita**

## **Diagnosis of Canine Heart Diseases with Special Reference to Transthoracic Echocardiography**

*Rimjhim Das*

A total of 14050 dogs were registered; out of which 88 dogs were suspected for heart diseases based on clinical manifestations and 38 dogs with overall incidence rate of 0.27% were diagnosed with various heart diseases based on thoracic radiography, electrocardiography and two-dimensional, M-mode and colour-flow Doppler echocardiography. The incidence of cardiac affections were found to be highest in Labrador Retriever (39.47%), male dogs (63.15%), age group of >6-9 years (31.57%).

Radiographically 20 dogs were diagnosed with cardiac affections and found Pleural effusion with highest occurrence (23.68%), followed by left sided cardiomegaly (21.05%) and right sided cardiomegaly (7.89%).

Electrocardiographically 30 dogs were diagnosed positive for cardiac affections with highest occurrence of Sinus bradycardia (23.68%) followed by P-mitrale (18.42%), ventricular hypertrophy and pericardial effusion (7.89% each), 1st degree AV block, Ppulmonale and myocardial disease (5.26% each), ventricular septal enlargement and atrial fibrillation (2.63% each). However, transthoracic echocardiography was taken as gold standard diagnostic modality with which 38 dogs were diagnosed positive for heart diseases.

The most frequently diagnosed cardiac disease using 2D-mode, M-mode were Dilated Cardiomyopathy (DCM) (47.36%), Left atrial (LA) enlargement (15.78%), Pericardial effusion, Left ventricular posterior wall (LVPW) hypertrophy (7.89%) and Right ventricular (RV) hypertrophy(5.26%). With Doppler mode echocardiography the occurrence of Mitral valve insufficiency was found to be highest (65.78%) followed by Tricuspid valve insufficiency (52.63%) and aortic valve insufficiency (10.52%).

The haematological parameters i.e. TEC, TLC, thrombocytes, lymphocytes, granulocytes, monocytes and Hb and biochemical parameters i.e. SGPT, SGOT, BUN, Creatinine, Total protein, albumin, sodium and potassium revealed non-significant ( $p>0.05$ ) role in diagnosis of cardiac affections in dogs. However, serum calcium and non-specific LDH appeared to be significantly ( $p\leq 0.05$ ) influenced by occurrence of heart disease and both the parameters were found reliable for diagnosis of heart

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diseases. The serum Ca and non specific LDH can be used together in combination to improve the efficacy of diagnosis for cardiac affections.

The sensitivity, specificity and accuracy of thoracic radiography was found to be 58.82%, 76.19% and 65.45% respectively upon taking echocardiography as gold standard diagnostic method. Whereas, the sensitivity, specificity and accuracy of electrocardiography was found to be 81.08 %, 60% and 76.60% respectively.

Based on the present study electrocardiography was found to be more efficient in diagnosis of heart diseases for dogs in comparison to thoracic radiography. However, transthoracic echocardiography using two-dimensional, m-mode and colour-doppler has been found to be the most efficient diagnostic modality in diagnosis of heart diseases in dogs as 43.18% (n=38) were diagnosed positive out of 88 suspected cases for heart disease presented during the study period.

# **Diagnosis and Treatment of Alimentary Tract Disorders in Dogs with Special Reference to Surgical Affections**

*Ritu Raj Saikia*

The present investigation was undertaken to study various affections of alimentary tract disorders in the canine patients presented in the OPD of VCC and Department of Surgery & Radiology, CVSc, AAU, Khanapara. The study conducted with the objectives to elucidate the incidence of alimentary tract disorders, diagnosis of alimentary tract disorders cases with the help of history, radiography, ultrasonography, haematobiochemical changes and to treat and assess the outcome of those cases.

Highest incidence was observed in anal sac affection (23.58%) followed by gingivitis/stomatitis (15.45%), gastrointestinal foreign bodies (11.38%), rectal prolapse (10.57%), oral tumour (8.94%), intussusception (6.50%), perianal tumour (5.69%), oesophageal/pharyngeal foreign bodies (4.88%), Gastric dilatation (4.07%), Paralytic ileus (3.25%), fecolith (2.44%), gastric dilatation and volvulus (1.63%) and megaesophagus (1.63%). Highest incidence of alimentary tract disorder was found in the age group of  $\leq 0-1$  years (30.89%) and least incidence was found in the age group of  $>10$  years. Breed wise incidence of present study revealed alimentary tract disorders are mostly prevalent in non-descript (32.52%) dogs, followed by Labrador (21.97%) and least prevalent in bull dog (0.81%). Sex wise incidence of the present study revealed 65.04% affected dogs were males and only 34.96% were females. The animals were categorized into four groups. Most common clinical symptoms exhibited by the dogs with oral cavity disorders included anorexia, plaque and calculus formation, halitosis, salivation. Disorders of oesophagus exhibited clinical signs such as hypersalivation, retching, dysphagia, cough reflex in oesophageal foreign body and persistent regurgitation just after feeding, weight loss, stiff gait, generalized weakness and emaciation in megaesophagus. Gastrointestinal disorders exhibited clinical signs such as vomiting, diarrhoea, dehydration, haematochezia and haematemesis. Anorectal disorders exhibited clinical signs such as scooting, anal licking, haematochezia, dyschezia and swollen anal sac. Both radiography and ultrasonography were helpful for

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diagnosis of alimentary tract disorders. Radiopaque foreign bodies and fecolith were confirmed with the help of conventional radiograph while radiolucent foreign bodies were confirmed with contrast radiography. Dilated oesophagus was seen in megaesophagus in both conventional and contrast radiographs. Paralytic ileus cases confirmed with dilated intestinal loops and availability of contrast agent in the intestine even after 24 hours. Intussusception cases confirmed with concentric hypoechoic and hyperechoic area on USG. Foreign bodies and fecolith confirmed by hyperechoic structures with distal acoustic shadowing on USG. There was no significant difference observed in Hb, TEC, TLC, DLC count in all the dogs of all the groups affected with various alimentary tract disorders compared to healthy animals except in anorectal disorders where there was significant increase in TLC and granulocyte and significant decrease in lymphocyte were observed and in oral cavity disorders there was significant increase in granulocyte count. There was no significant difference observed SGPT, SGOT, BUN and Creatinine values of affected animals compared to healthy animals except in Oral cavity disorders where there was significant increase in BUN and creatinine value. Sodium, potassium, chloride all decreased significantly in gastrointestinal disorders when compared to healthy animals. Cases were treated with both medicinally and surgically. Various surgical methods were used such as gastrotomy, enterotomy, intestinal resection and anastomosis, colopexy depending upon the type of affections.



## **Diagnosis and Treatment of Spinal Affections in Dogs and Cats**

*Shantishree Das*

A total of 3130 dogs and 533 cats were presented in the Department of Veterinary Surgery and Radiology and Surgery Out Patient Department (SOPD), Veterinary Clinical Complex, College of Veterinary Science, Assam Agricultural University, Khanapara during the period from 1st November 2021 to 31st July 2022. Overall incidence of spinal affections 0.73 percentage and 1.68 percentage was recorded in dogs and cats respectively. Incidence of spinal affections in male dogs (65.22 percentage) and in female cats (66.66 percentage) was highest. Non-descript dogs (30.43 percentage) and cats (88.88 percentage) were found to highly prone to spinal affections. Motor vehicle accident (30.43 percentage) and dog bites (44.44 percentage) was found to be the prime cause of spinal trauma in dogs and cats respectively. Thoracolumbar region was found to be at highest risk.

Out of the total spinal affection cases presented, 13 dogs and 5 cats were taken under current study. The animals were evaluated clinically on the basis of physiological, Orthopedic and neurological examination. Survey and contrast radiography was taken for confirmation of the spinal affections. After confirmation, 7 dogs and 2 cats were treated conservatively out of which 2 dogs (28.57 percentage) and 1 cat (50 percentage) showed neurological recovery, whereas, 6 dogs and 3 cats were treated surgically (with pedicle screws, spinal stapling and hemilaminectomy) out of which 1 dog (16.66 percentage) and 2 cats (66.67 percentage) showed neurological recovery followed by physiotherapy using TENS, infrared light and hot fomentation.

At 20th day post-treatment there was an insignificant rise in ALP concentration of dogs and cats which could be due to inflammatory phase of healing, osteoblastic activity and administration of the steroids. The mean value of LDH concentration was found to be highly significant. CSF was collected via cisternal tap and evaluated chemically, macroscopically and microscopically. Neutrophils were observed in high number at the reporting time.

Animals reported within 24 hours of affection with intact deep pain reflex showed better recovery. So, earlier the case presented, better is the recovery.

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**Abstract of M.Sc. thesis**

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