14th International Conference
On
Recent Innovations and Sustainable Approaches in Agricultural, Biological and Applied Sciences for Livelihood Security (RISAABASLS-2026)

Venue: Uttar Banga Krishi Vishwavidyalaya, Pundibari, Cooch Behar, West Bengal, India

June 18-20, 2026

Abstract Book Cum Souvenir

Editors

Prabhat Kumar Pal
Chhatarpal Singh
Sumit Chakravarty
Sanjay Kumar Jha

Organized by

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Uttar Banga Krishi Vishwavidyalaya (UBKV),
Pundibari, Cooch Behar, West Bengal, India
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Editors

Prof. Prabhat Kumar Pal
Head (Agril. Extension) and Director of Extension Education, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal, India

Dr. Chhatarpal Singh
President, Agro Environmental Development Society (AEDS), Rampur, U.P., India

Prof. Sumit Chakravarty
Secretary, COBACAS, Professor, Forestry UBKV, Pundibari, Cooch Behar, West Bengal, India

Prof. Sanjay Kumar Jha
Professor, Central Department of Botany, Tribhuvan University, Kritipur, Kathmandu, Nepal

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14th International Conference

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Recent Innovations and Sustainable Approaches in Agricultural, Biological and Applied Sciences for Livelihood Security (RISAABASLS-2026)

Disclaimer

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উত্তরবঙ্গ কৃষি বিশ্ববিদ্যালয়

পুণ্ডিবাড়ী, কোচবিহার , পশ্চিমবঙ্গ–৭৩৬১৬৫

UTTAR BANGA KRISHI VISWAVIDYALAYA

P.O. PUNDIBARI, DIST. COOCH BEHAR, WEST BENGAL- 736165

প্রফেসর দেবব্রত বসু
উপাচার্য
Prof. Debabrata Basu
M.Sc. (Ag.), Ph.D., DDE
Vice-Chancellor

মো./Mob: +91-9434748016
ইমেল/E-mail: vc@ubkv.ac.in
vcubkvv@gmail.com
ওয়েবসাইট/ Website: www.ubkv.ac.in

Date: 11.06.2026

MESSAGE

It gives me immense pleasure to learn that the Department and Directorate of Extension Education, Uttar Banga Krishi Viswavidyalaya, in collaboration with the Agro Environmental Development Society (AEDS) and Cooch Behar Association for Cultivation of Agricultural Sciences (COBACAS), is organizing the 14th International Conference on *"Recent Innovations and Sustainable Approaches in Agricultural, Biological and Applied Sciences for Livelihood Security (RISAABASLS-2026)"* and bringing out this Abstract Volume.

This conference offers an excellent platform for researchers, academicians, students, and professionals to share their innovative findings, exchange ideas, and engage in meaningful scientific deliberations. It will not only enable young researchers to showcase their work before an international audience but also provide opportunities to learn from distinguished scientists and experts from diverse disciplines.

The initiative of the Agro-Environmental Development Society (AEDS) to confer prestigious awards is highly commendable. Such recognition serves as a source of inspiration for emerging researchers and academicians while honouring senior professionals for their valuable contributions to science and society. This thoughtful endeavour will undoubtedly promote excellence and innovation in research and development.

The abstracts compiled in this volume reflect significant scientific advancements, novel research insights, and interdisciplinary approaches aimed at addressing contemporary challenges in agriculture, biological sciences, environmental sustainability, and livelihood security. I am confident that the exchange of knowledge and experiences during the conference will strengthen collaborative efforts and contribute meaningfully to sustainable and inclusive development.

I extend my heartfelt congratulations to the organizers, contributors, and participants for their dedicated efforts and convey my best wishes for the grand success of the conference and its deliberations.

(D. Basu)

উত্তরবঙ্গ কৃষি বিশ্ববিদ্যালয়
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প্রফেসর আভাস কুমার সিনহা
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Prof. Abhas Kumar Sinha
Registrar (Acting)

মোবাইল/Mobile: +91 9434096763 (O)
ইমেল/E-mail: registrar@ubkv.ac.in
registrarubkvv@gmail.com
ওয়েবসাইট/Website: www.ubkv.ac.in

Date: 11.06.2026

MESSAGE

I am delighted to know that the 14th International Conference on *"Recent Innovations and Sustainable Approaches in Agricultural, Biological and Applied Sciences for Livelihood Security (RISAABASLS-2026)"* is being organized at Uttar Banga Krishi Viswavidyalaya.

The Abstract Volume showcases valuable scientific contributions from researchers and academicians across diverse disciplines. I am confident that the conference will provide an excellent platform for knowledge exchange, collaboration, and innovation towards sustainable agricultural and rural development.

I congratulate the organizers, authors, and participants for their efforts and extend my best wishes for the successful conduct of the conference.

(A. K. Sinha)

UTTAR BANGA KRISHI VISWAVIDYALAYA

P.O. Pundibari, Dist. Cooch Behar
PIN -736165, West Bengal, India
Mobile : +7584002617; e-mail: pkpalubkv@gmail.com; dee@ubkv.ac.in

From:
Dr. Prabhat Kumar Pal
Professor & Head, Dept. of Agril. Extension; and
Director of Extension Education (Actg.)

Date: 11.06.2026

MESSAGE

It is a matter of pride that the Department and Directorate of Extension Education, Uttar Banga Krishi Viswavidyalaya, in collaboration with the Agro Environmental Development Society (AEDS) and Cooch Behar Association for Cultivation of Agricultural Sciences (COBACAS) is organising the 14th International Conference on *"Recent Innovations and Sustainable Approaches in Agricultural, Biological and Applied Sciences for Livelihood Security (RISAABASLS-2026)"* during June 18-22, 2026.

The conference provides a unique platform for scientists, academicians, extension professionals, policymakers, students, and development practitioners from across the globe to share their innovative research findings, experiences, and insights on sustainable agricultural development and livelihood security. The themes covered in this conference are highly relevant to the present-day needs of agriculture and allied sectors and will undoubtedly stimulate fruitful discussions, collaborations, and future research initiatives.

I sincerely congratulate all the authors for their valuable contributions and appreciate the efforts of the organizing committee, reviewers, and all stakeholders involved in bringing out this Abstract Volume. I am confident that the proceedings will serve as a useful reference for researchers, educators, extension professionals, and development agencies working towards sustainable livelihood enhancement.

As the application arm of the University, the Directorate of Extension Education remains committed to facilitating the transfer of scientific innovations from laboratories to farmers' fields and assuring that the research outcomes documented in this volume will contribute meaningfully to sustainable and resilient future and societal welfare.

(P. K. Pal)

Cooch Behar Association for Cultivation of Agricultural Sciences (COBACAS)
Department of Genetics and Plant Breeding, Uttar Banga Krishi Viswavidyalaya
Pundibari, Cooch Behar 736 165, West Bengal, India
E-mail: cobacas2013@gmail.com; Website: http://cobacas.org.in
(Paper submission: editorjat2014@gmail.com)
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(Under West Bengal Societies Registration Act XXVI of 1961)

Dr. Sumit Chakravarty
Secretary, COBACAS; Professor, Forestry UBKV Pundibari

COBACAS/UBKV/2026-2027/01 **Date: 10-06-2026**

MESSAGE

I am extremely gratified to learn that the Department and Directorate of Extension Education, Uttar Banga Krishi Vishwavidyalaya, in collaboration with the Agro Environmental Development Society (AEDS) and Cooch Behar Association for Cultivation of Agricultural Sciences (COBACAS), is organizing the 14th International Conference on **"Recent Innovations and Sustainable Approaches in Agricultural, Biological and Applied Sciences for Livelihood Security (RISAABASLS-2026)"** during 18–20 June 2026 at Uttar Banga Krishi Vishwavidyalaya, Pundibari, Cooch Behar, West Bengal.

The theme of this conference is highly relevant in the present era, where the challenges of food security, climate change, natural resource degradation, biodiversity conservation and sustainable livelihood development demand innovative and interdisciplinary scientific solutions.

I am particularly delighted to note that eminent scientists, academicians, extension professionals, industry representatives, researchers and students from various reputed institutions have come together to participate in this prestigious event. Such a congregation of experts will undoubtedly facilitate meaningful exchange of ideas, foster scientific collaboration, strengthen research networks and generate innovative strategies for addressing contemporary challenges in agriculture and allied sectors.

Conferences of this nature play a major role in disseminating scientific knowledge, encouraging young researchers and promoting collaborative research initiatives that contribute towards the advancement of science and society. I am confident that the exchange of ideas and recommendations emerging from this conference will provide valuable insights for sustainable agricultural development, environmental conservation and livelihood enhancement.

I sincerely appreciate the efforts of the organizers, members of the organizing committee, collaborators and all stakeholders for taking the initiative to organize this important international event. I also extend my best wishes to all the delegates, researchers and participants for fruitful interactions and successful deliberations.

I wish the 14th International Conference (RISAABASLS-2026) a grand success.

Secretary

Central Department of Botany
Tribhuvan University (TU)
Kritipur, Kathmandu, Nepal

Prof. Sanjay Kumar Jha, PhD
Professor, TU, Kathmandu
Email:sanjay.jha@cdbtu.edu.np
Website:*www.cdbtu.edu.np*
Mobile: +977-9843051710

Message

It is immense pleasure that "Agro Environmental Development Society (AEDS)" is going to organize 14th International Conference on **"Recent Innovations and Sustainable Approaches in Agricultural, Biological and Applied Sciences for Livelihood Security (RISAABASLS-2026)**" at Uttar Banga Krishi Vishwavidyalaya (UBKV), Pundibari, Cooch Behar, West Bengal, India during June 18-20, 2026 in collaboration with Department & Directorate of Extension Education, Uttar Banga Krishi Vishwavidyalaya (UBKV), Pundibari, Cooch Behar, West Bengal. I warmly welcome to all the participants and delegates at Cooch Behar, a rich treasure of biodiversity with different natural resources. The city has historical land and surrounded by beautiful landscape.

This types of seminar and symposia are an important platform which helps in harnessing the research and communication skills of scientists, researchers, students and farmers. Such scientific gathering is the important part of knowledge shearing among the scientists. The topic of conference is very relevant because multi-disciplinary interactions are more useful to take a holistic view of a problem. After industrialization, Environment and climate changing has been the main causality, thus forcing all the countries to build a consensus to combat the same.

I am pleased to welcome all the delegates and participants in the 14th International Conference and I wish thank to all the members of organizing committee for their great efforts and suggestion to make this conference a grand success.

Sanjay

Prof. Sanjay Kumar Jha

एग्रो एनवायर्नमेंट्ल डेवलपमेंट सोसाइटी (ए.ई.डी.एस.)
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डॉ. छत्रपाल सिंह
Dr. Chhatarpal Singh
President, AEDS
Organizing Secretary, RISAABASLS-2026

Phone: 91-6394082801
E-Mail: cpsingh.2012@gmail.com
Website : www.aedsi.org

Message

As organizing secretary, I warmly welcome to all the dignitaries, delegates and participants in the 14th International Conference on "**Recent Innovations and Sustainable Approaches in Agricultural, Biological and Applied Sciences for Livelihood Security (RISAABASLS-2026)**". The conference is going to be organized by Agro Environmental Development Society (AEDS) Rampur, Uttar Pradesh & Department & Directorate of Extension Education, Uttar Banga Krishi Vishwavidyalaya (UBKV) at UBKV, Pundibari, Cooch Behar, West Bengal, India from June 18-20, 2026. The AEDS is continuously working in the agriculture and allied sectors and organizing various training, seminar and conference to keep the students, researchers and scientists encourage. The main focus of the society and conference is how to overcome the problems that are arising for the sustainable development and how to increases entrepreneurship with the low expenditure in agriculture and allied sectors.

I am very much thankful to our respected Chief Patron Prof. D. Basu Ji, Hon'ble Vice Chancellor, Uttar Banga Krishi Viswavidyalaya (UBKV), Pundibari, Cooch Behar, West Bengal, India for his consent to organize 14th International Conference at UBKV. My special thanks to Organizing Chairman, Prof. Prabhat Kumar Pal Ji, Head (Agril. Extension) and Director of Extension Education, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar and Prof. Sumit Chakravarty, Secretary, COBACAS and Professor, Forestry UBKV Pundibari for supporting and conducting this conference in joint collaboration.

I am also thankful to all the respective participants and committee members for their valuable support and guidance during the conference.

I once again express my heartfelt gratitude to all esteemed Delegates and Participants for taking part and enhancing the dignity of this conference and sharing their views on different aspects of Agriculture, Environment, Applied Sciences & Livelihood Security and making this conference grand success.

Dr. Chhatarpal Singh

CONTENTS

Lead/Invited Lectures & Oral/Poster Presentation

Disease Assessment in Dragon fruit (*Selenicereus costaricensis*) and Exploring the Efficacy of Essential Oils against Selected Fungal Pathogens

Sanjay Kumar Jha and Deepa Sharma
Central Department of Botany Tribhuvan University, Kirtipur, Kathmandu, Nepal
Email: sk.jha@cdb.tu.edu.np

Abstract

Dragon fruit (*Selenicereus costaricensis*) is a high-value crop, but in recent times, its production and postharvest quality have been affected by fungal diseases. This study was carried out to find the major fungal pathogens associated with diseases in dragon fruit and to evaluate the effectiveness of plant essential oils in controlling them. The dragon fruit farm in Bhakundebesi, Kavrepalanchowk, was selected for the collection of infected stem samples, and the Kalimati and Kuleshwor fruit market was selected for the collection of infected fruit samples. The fungal pathogens were cultured and isolated using Potato Dextrose Agar (PDA) and identified based on their macroscopic and microscopic features. Altogether eight fungal species were isolated from the infected stem and fruit samples, among which *Alternaria alternata*, *Aspergillus flavus*, and *Penicillium chrysogenum* were the most common ones. The growth of these fungi was tested in different concentrations of essential oils at 40, 20, 10, and 5ìl/ml from *Cinnamomum tamala*, *Cymbopogon citratus*, and *Eucalyptus camaldulensis* using the poisoned food technique. All three of these essential oils controlled the growth of fungus, among which *Eucalyptus camaldulensis, Cinnamomum tamala, and Cymbopogon citratus* showed the highest antifungal activity against *Alternaria alternata* (85.7%), *Aspergillus flavus* (87%) and Penicillium chrysogenum (85.1%) respectively. Therefore, the study showed the major fungal pathogens responsible for the disease and the importance of essential oils and their use as eco-friendly alternatives to synthetic fungicides for controlling pre- and postharvest fungal diseases in fruits.

Keywords: *Antifungal activity, GC-MS, Post-harvest Disease, Pathogenicity, Food safety*

Climate smart agriculture systems: Transforming food systems under a changing climate.

Abhijeet Kuderiya[1*], Chetna Pathak[2].
[1&2] PhD Scholar, Jawaharlal Nehru Krishi Vishwavidyalaya, Jabalpur – 482004 - (M.P.), India.
****Corresponding author email address: kuderiyaabhijeet@gmail.com***

Abstract

Climate-smart agriculture (CSA) systems have emerged as an innovative and sustainable approach to address the growing challenges of food insecurity, environmental degradation, and climate change. With rising temperatures, erratic rainfall patterns, increasing frequency of droughts, floods, and pest outbreaks, conventional agricultural systems are becoming more vulnerable and less productive. Climate-smart agriculture aims to transform food systems by simultaneously achieving three core objectives: increasing agricultural productivity and incomes, enhancing resilience and adaptation to climate variability, and reducing greenhouse gas emissions wherever possible. CSA systems integrate a range of practices and technologies such as conservation agriculture, agroforestry, integrated nutrient management, water-efficient irrigation, climate-resilient crop varieties, crop diversification, precision farming, and digital advisory services. These interventions improve soil health, conserve water resources,

enhance biodiversity, and strengthen the adaptive capacity of farming communities. For example, drought-tolerant seeds and efficient irrigation methods help maintain yields under water stress, while agroforestry and carbon-smart land management contribute to carbon sequestration and ecosystem restoration. The transformation of food systems through CSA extends beyond farm-level production to include sustainable value chains, post-harvest management, market access, renewable energy use, and policy support mechanisms. Digital tools such as weather forecasting, mobile-based advisories, remote sensing, and artificial intelligence enable timely decision-making and risk management. These innovations empower farmers, especially smallholders, women, and marginalized groups, to respond effectively to changing climatic conditions. However, the large-scale adoption of climate-smart agriculture faces barriers including limited financial resources, lack of awareness, inadequate institutional support, and weak extension systems. Strengthening research, investment, public-private partnerships, and inclusive policies is essential to mainstream CSA practices. In conclusion, climate-smart agriculture systems provide a transformative pathway for building resilient, productive, and sustainable food systems under a changing climate. By integrating adaptation, mitigation, and food security goals, CSA can play a vital role in ensuring long-term agricultural sustainability and global well-being.

Keywords: *Climate-smart agriculture, Food systems, Climate change, Resilience, Sustainable agriculture, Adaptation.*

Farmers' Awareness and Perceptions of Soil Health Management in Balurghat Block of Dakshin Dinajpur District

Abhishek Roy[1*] and Biswajit Goswami[2]

[1]Ph.D. Scholar, Department of Agricultural Extension, Visva-Bharati, Santiniketan, Birbhum, West Bengal

[2]Biswajit Goswami, Associate Professor, Department of Agricultural Extension. Visva-Bharati, Santiniketan, Birbhum, West Bengal

Corresponding author's mail: abhishekroypsb55@gmail.com

Abstract

Soil health management plays a crucial role in sustaining agricultural productivity and environmental quality. A village-level survey was conducted among small and marginal farmers in the Balurghat Block of Dakshin Dinajpur district, West Bengal, to assess their perceptions and practices related to soil health management using a participatory approach. The study revealed that the application of organic matter was generally inadequate among the respondents, despite nearly 90 percent of the farmers recognizing its positive contribution to soil health. About 49.3 percent of the farmers reported not receiving any technical guidance on soil management, while the remaining respondents, predominantly small farmers, obtained advice from village-level extension personnel. Basic awareness regarding the importance of soil testing was observed among many small farmers and a few marginal farmers. However, the use of micronutrients was largely neglected due to limited knowledge of their role in crop production. Fertilizers were mainly applied through broadcasting, often along with partially decomposed or undecomposed organic materials. The application of lime was confined to farmers who had received recommendations from extension functionaries. Some respondents also reported observing nutrient deficiency symptoms, such as crop reddening. Farmers perceived that increasing reliance on inorganic

fertilizers is necessary to maintain crop productivity. The findings underscore the need for strengthened extension services and awareness-generation programmes to promote scientific soil health management practices among small and marginal farmers, thereby contributing to sustainable agricultural development in the region.

Keywords: *Soil health management, productivity, organic matter, awareness, extension services*

Assessing Farmers' Training Needs through RAWE: A Case Study of Akbarpur Village in Mathura District

Akanchha Singh[1] and Arpit Huria[2]

[1]Assistant Professor, Department of Agricultural Extension and Communication, Faculty of Agricultural Sciences, GLA University, Mathura, [2]Research Associate (Social Science-Gender Studies), Centre of Excellence on Sustainable Land Management, ICFRE, Dehradun, Uttarakhand

Corresponding author e-mail: singhakanchha3@gmail.com

Orchid id: https://orcid.org/0009-0008-3360-9951

Abstract

Training is vital for increasing human performance in any setting. Effective training programs assist farmers in improving their farming techniques, making educated decisions, and utilizing resources more efficiently. RAWE (Rural Agricultural Work Experience) places B.Sc. (Hons.) Agriculture students directly in village settings where they engage with farmers through observation, interviews, and participation in farm activities. This close interaction enables students to systematically identify gaps in knowledge, skills and adoption thereby assessing the training needs of farmers based on real constraints. The current study was carried out to determine the training needs of farmers in Akbarpur village, Choumuhan block, Mathura district, in order to give farmers, the required interventions, such as training and local demonstrations. Akbarpur village was purposefully chosen due to its fertile agricultural environment and abundant resources. A total of 104 farmers were randomly selected from the village and their responses regarding the necessity for training in various agricultural practices were recorded and ranked using mean scores. Findings revealed that the majority of farmers were young, had completed high school, earned less than 5 lakhs, and owned less than 5 acres of land. Farmers highlighted four primary training areas: soil sampling and testing, crop protection, understanding of government schemes, FPOs, and SHGs, and nutrient and weed management. Based on the identification of training needs of farmers, appropriate interventions were framed by the researcher and carried out by the students under the guidance of concerned experts. The interventions included demonstrations (for soil sampling and testing & nutrient and weed management), *Kisan Goshti* (interaction sessions with experts on crop protection) and *Nukkad Nataks* (to raise awareness about government schemes, SHGs and FPOs). As per the feedback received on five-point continuum regarding the training programme, majority (65%) of farmers were very satisfied by the interventions, followed by satisfied (35%) responses. It is necessary to study the local conditions and needs of farmers before executing any interventions or trainings. The impact of training can be exponentially increased if the training is based on needs and interests of farmers. Thus, RAWE served as a dual-capacity platform, strengthening farmers' skills through need-based interventions while equipping future agri-professionals with practical expertise in diagnosis, extension planning, and implementation.

Keywords: *Training Need Assessment (TNA), Interventions, RAWE*

Study the effect of quantitative and qualitative parameters on carrot (*Daucas carota* L.) genotypes

Ananda Ray[1], Shreyasee Manta[2], Suchand Datta[3,*]

[1]Department of Vegetable crops and spices, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar West Bengal -736165

[2]Department of Vegetable crops, ICAR- Indian institute of Horticultural Research, Bangalore, Karnataka- 560089

[3]Professor, Department of Vegetable and Spice Crops, Uttar Banga Krishi Viswavidyalaya, Pundibari, Coochbehar, West Bengal – 736165, India

Corresponding author e-mail: suchanddatta@gmail.com

Abstract

A field experiment was conducted at the Horticultural Farm, Uttar Banga Krishi Viswavidyalaya, Cooch Behar in the year 2022 to 2023, to study the effect of different sowing times on quantitative and qualitative parameters of carrot (*Daucas carota* L.) genotypes. The experiment was laid out in a randomized block design consisting of five different sowing dates: October 23 (S_1), November 7 (S_2), November 22 (S_3), December 7 (S4), and December 21 (S5) and five genotypes: Early Nantes (V_1), CARTEVAR-1 (V_2), CARTEVAR-3 (V_3), CARTEVAR-4 (V_4), and CARTEVAR-6 (V_5). It had been found that maximum plant height (56.32 cm), root length (12.36 cm), collar diameter (4.32 cm), root weight per plant (131.42 g), and root yield per hectare (26.45 t/ha) were observed sown on November 22nd (S_3). Among all the genotypes, CARTEVAR-3 (V3) was recorded maximum plant height (59.02 cm), root length (12.52 cm), collar diameter (4.33 cm), root weight per plant (143.88 g), and root yield per hectare (28.07 t). whereas, minimum root cracking percentage (5.40%) and maximum beta-carotene (10399.20 g/100 g) were observed in the variety CARTEVAR-3. Genotype CARTEVAR-6 showed the maximum TSS (7.48p B). Maximum plant height (62.74 cm), collar diameter (4.78 cm), root length (14.11 cm), root weight per plant (181.04 g) and yield per hectare (29.88 t/ha) have been recorded under the combination of S3V3 (22 November + CARTEVAR-3). Therefore, variety CARTEVAR-3 showed promising results over other genotypes and November 22 was found to be the ideal sowing time for carrot cultivation.

Keywords: *Carrots, Sowing time, genotype, Quantitative, qualitative, yield*

Socio-Economic Dynamics of Integrated Farming Systems: An Empirical Analysis of Income Distribution Disparity and Labor Absorption in the North-Eastern Hill Region of India

Madhumita Naskar, *Anju Choudhury

PhD Scholar, Visva-Bharati University, Santiniketan, Department of Agricultural Economics.
Assistant Professor (Agricultural Economics), Department of Agricultural Economics, College of Agriculture, CAU, Iroisemba, Manipur

Abstract

This study investigates the socio-economic and environmental implications of the Integrated Farming System (IFS) in the Ri-Bhoi district of Meghalaya, India. Grounded in the principle that "waste is only a misplaced resource," IFS promotes the cyclic flow of nutrients where byproducts from one component serve as essential inputs for another. Using a multi-stage proportionate random sampling technique, data were collected from 100 households (50 IFS adopters and 50 non-adopters) in the Umsning block. The research employed the Gini coefficient and Lorenz curve to measure income inequality, while multiple linear regression was utilized to analyze the factors influencing employment generation. The findings reveal that IFS adopters achieved significantly higher and more diversified income streams compared to non-adopters. While non-adopters relied primarily on traditional farming and piggery (averaging ¹ 106,000 and ¹ 116,000 respectively), adopters successfully integrated dairy, poultry, and fisheries, with piggery earnings reaching ¹ 111,000. However, the study found a larger Gini coefficient among IFS farmers, indicating higher income inequality within the group. This disparity is attributed to the varying degrees of success in managing multiple agricultural components compared to the more uniform, lower-income profile of traditional farmers. Regarding labor utilization, IFS demonstrated a robust capacity for employment generation. Adopters utilized an average of 145 man days for crop farming, compared to 120 man days for non-adopters. The integration of livestock and aquaculture further increased labor demand, with dairy alone requiring 180 man days. The results underscore that while IFS requires higher labor intensity and intensive management, it offers a viable pathway toward sustainable agriculture and enhanced rural livelihoods. The study concludes that tailored management strategies and innovative technologies are essential to mitigate socio-economic trade-offs and protect the natural resource base, ensuring the long-term viability of integrated systems in mountainous regions like Meghalaya.

Keywords: *Integrated Farming System, Meghalaya, Income Inequality, Employment Generation, Gini Coefficient, Sustainable Agriculture.*

Optimizing soil biological functionality through conservation agriculture and sulphur-driven nutrient cycling in pearl millet-based dryland agroecosystem

Ankit[1]*, K.S. Rana[2], R.S. Bana[2], Ajay Kumar[1], and A. Anadan[1]

[1]ICAR-National Institute of Seed Science & Technology, Mau 275 103, Uttar Pradesh, India

[2]ICAR-Indian Agricultural Research Institute, New Delhi 110 012, India

****Corresponding author email: ankit.tiwari2601@gmail.com***

Abstract

The productivity of pearl millet, a kingpin of drylands, has reached to a plateau owing to erratic moisture availability and poor soil biological health. Hence, transitioning pearl millet-based dryland farming to conservation agriculture, a field experiment was conducted during the 2021 and 2022 at the research farm of the Indian Agricultural Research Institute, New Delhi to evaluate soil biological functionality under conservation agriculture and sulphur-driven nutrient cycling. Pearl millet variety Pusa 443 was sown under zero tillage with crop residue mulching (ZTCR), zero tillage (ZT), and conventional tillage (CT) as main plots along with six sulphur (S) feeding strategies - S control (S0), recommended dose of sulphur (RDS) through elemental S at 30 kg/ha 20 days advance of sowing, single foliar spray of ammonium thiosulphate (ATS) at 0.5% and 1.0% concentrations at 20 days after sowing (DAS), and

two foliar sprays of ATS at 0.5% and 1.0% at 20 and 50 DAS allocated as subplots under a split-plot arrangement with 3 replications. Results indicated that ZTCRM significantly improved the grain yield by 25.8 and 13.0% and enhanced activities of dehydrogenase (DHA), alkaline phosphatase (ALP), and urease (UA), exceeding ZT and CT by up to 40.9%, 39.0%, and 100%, respectively. Hence, least soil disturbance and crop residue mulching underpin soil health and fertility in dryland agroecosystems through enhanced soil moisture retention, moderated temperature, and improved porosity. While RDS resulted in the highest values for grain yield and DHA, ALP, and UA activities owing to incremental effect on available sulphate in the rhizosphere, foliar S feeding through ATS had no significant influence on these soil enzyme activities, however, significantly improved grain yield over control. Therefore, integrating conservation agriculture principles is crucial for advancing climate-smart, microbiome-driven soil health and sustained productivity of pearl millet in rainfed dryland ecologies of Delhi and similar moisture-limited dryland agroecosystems.

Keywords: *Crop residue mulching, Soil biological activity, Soil enzyme, Yield, Zero tillage*

Forest-Based Ecosystem Services and Livelihood security of the Birhor Tribe in Jharkhand

Anuj Goswami[1*]

[1]Division of Rural and Tribal Development, Ramakrishna Mission Vivekananda Educational and Research Institute (RKMVERI), Ranchi, Ramakrishna Mission Ashrama, Morabadi, Ranchi 834008, Jharkhand

****Corresponding author e-mail: anuj2rk@gmail.com***

Abstract

This study searches the significance of ecosystem services (ES) for supporting the livelihood of the Birhor tribe of Jharkhand, which are identified as a particularly vulnerable tribal group (PVTG), that has long term dependence on forests and its ES. This study looks at how the ES supports their traditional way of life. The Birhor have historical dependence on provisioning services like fuelwood, wild foods, medicinal plants, and natural fibres for their traditional rope making. Alongside to sustaining their subsistence economy these resources have been an integral part in shaping their cultural identity and traditional way of life.

This study points out that the Birhor are facing serious environmental challenges, includes the deforestation, degradation of natural habitats, decreasing forest resources, and restricted access to the forest, ES are still the backbone of livelihood of the Birhor. Hunting, gathering and small scall farming practices are still important economic activities, although their importance has gradually declined with the rapid change in socioeconomic and environmental situations. To deal with this, the community has expanded its livelihood strategies by involving in wage labour and marginal farming to support household income and reduce dependence on declining forest resources.

The results shows that traditional ecological knowledge keeps guiding the community to use the natural resources sustainably and preserve the cultural links with the environment. The study highlights the complex connection between the community resilience, livelihood security and ES availability. It highlights the necessity of development strategies that balances the livelihood improvement with ecological protection, ensuring that initiatives are participatory and sensitive to cultural diversity.

The study comes to the conclusion that ES are still essential to the Birhor community's survival, well-being and cultural continuity. Strengthening resilience and fostering long term socioeconomic and

environmental sustainability among the Birhor people needs sustainable management of forest ecosystems coupled with livelihood support programs.

Keywords: *Ecosystem services, Livelihood, Sustainability, Birhor, PVTG*

Development of Banana Powder and Value-Added Products: HPLC-Based Assessment of Fructooligosaccharide Content, Nutritional Analysis, and Shelf-Life Evaluation

Anukrati Sekhri[1*] and Dr. Ragini Ranawat[2]

[1*]Research Scholar, Department of Community and Applied Science, University of Rajasthan, Jaipur.
Email: anukratisekhri23@gmail.com

[2]Assistant Professor, Department of Community and Applied Science, University of Rajasthan, Jaipur.

Abstract

Bananas are one of the most commonly consumed fruits across the globe. While many varieties of the fruit are cultivated, *Robusta* banana (Musa acuminata) is a popularly consumed variety in India. The present study was undertaken to compare the nutritive composition of fresh *Robusta* banana with dried *Robusta* banana powder. Indian Food Composition tables (IFCT) were used for the reference values of fresh *Robusta* banana. For the dehydration process, controlled oven drying was conducted at 60°C for 10 hours. Using the prepared banana powder and other food ingredients, two food products namely Mango Parfait and Choco Yogurt Bites, were developed. The study also aimed to quantify two specific fructooligosasccharides found in banana, namely 1-kestose and Nystose, in the prepared banana powder as well as the prepared products, using High Performance Liquid Chromatography (HPLC). The developed food products were prepared in two batches; with and without preservatives. Potassium Sorbate (0.1%w/v) was used as a preservative, and shelf-life stability of both the products was assessed through microbiological testing combined with daily sensory evaluation. Nutritional composition of the prepared products was determined using the Indian Food Composition Tables (IFCT). The findings of the study support the potential of dried *Robusta* banana powder as a prebiotic ingredient in food product development.

Keywords: *Robusta banana; fructooligosaccharides; 1-kestose; Nystose; HPLC; functional foods*

Deciphering Genotypic Variation and Drought Adaptation in Maize (*Zea mays* L.) during the Reproductive Stage under Moisture Stress through Integrative Multivariate Analysis

Apurba Pal[1]*, Shreya Sen[2], Birendra Singh[2], Rakesh Deo Ranjan[1]

[1]Department of Plant Physiology and Biochemistry, BAC, Bihar Agricultural University, Sabour, Bihar-813210

[2]Department of Plant Breeding and Genetics, BAC, Bihar Agricultural University, Sabour, Bihar-813210

Corresponding e-mail: apapurbapal@gmail.com/ apurba2484@bausabour.ac.in

Abstract

Drought stress is a major constraint to maize productivity, necessitating the identification of drought-resilient genotypes and key adaptive traits. A field experiment was conducted during the summer of 2025 at Bihar Agricultural University, Sabour, India, to evaluate 30 maize (*Zea mays* L.) genotypes

under well-watered and moisture-stress conditions imposed at the knee-high (V6–V8) and tasselling (VT) stages. Soil moisture in stress plots declined from 85–90% to 45–50% field capacity, creating a controlled drought environment. Moisture stress significantly reduced leaf area (7.1%), root volume (15.2%), plant height (7.3%), leaf area index (7.1%), net assimilation rate (21.4%), crop growth rate (11.5%), relative growth rate (20.0%), chlorophyll content (8.2–13.9%), relative leaf water content (10.2%), grains cob{ ¹ (16.7%), grain weight (14.0%), and grain yield (16.0%). In contrast, drought enhanced protective biochemical responses, resulting in marked increases in proline (266.4%), total soluble sugars (146%), total soluble proteins (70%), glycine betaine (11%), total phenol (82.5%), catalase (21.1%), and peroxidase (16.3%). Under stress conditions, SKM 1 maintained superior growth performance and recorded the highest grain yield (15.51 t ha{ ¹), while DHM 117 exhibited maximum relative leaf water content (82.15%), proline accumulation (62.93 µmol g{ ¹ FW), and catalase activity (247.18 µmol H, O, decomposed min{ ¹ g{ ¹ FW), indicating strong osmotic adjustment and antioxidant defense. VMH 1650 showed superior plant height, chlorophyll retention, net assimilation rate, and grain weight across environments. Conversely, SML 180, SML 2, SML 21, and SML 25 were identified as highly susceptible genotypes. Correlation analysis revealed strong positive associations among growth, physiological, biochemical, and yield traits, whereas principal component analysis explained 68.8% of the total variation and clearly separated drought and control environments. MGIDI and MTSI analyses consistently identified SKM 1, DHM 117, and VMH 1650 as ideotype-proximal and stable genotypes, combining superior growth, stress tolerance mechanisms, reproductive resilience, and yield retention, making them promising candidates for climate-resilient maize breeding programs.

Keywords: *Zea mays, moisture stress, morpho-physiological traits, antioxidant defense, Osmolytes, multivariate analysis.*

Indigenous Dietary Practices for Psychological Wellness

Arju Saini[1], Dr. Poonam Malik[2]

[1]Ph.D. student, Department of Human Development and Family Studies, I.C College of Community Sciences, Chaudhary Charan Singh Haryana Agricultural University, Hisar 125004, Haryana

Email: saini99aarju@hau.ac.in

[2]Assistant Scientist, Department of Human Development and Family Studies, I.C College of Community Sciences, Chaudhary Charan Singh Haryana Agricultural University, Hisar 125004, Haryana

Email: pnmmalik@gmail.com

Abstract

Psychological Wellness is a cardinal integrant of Ayurvedic definition of 'Swasthya' along with Physical and Spiritual well-being. WHO defines mental health as a state of well-being in which every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to contribute to her or his community. All aspects of human life, including interpersonal connections, emotional and personal well-being, and effectively contributing to society, depend on psychological wellness. Indigenous food systems provide important insights into preventive and comprehensive well-being, whereas modern approaches to mental health mostly concentrate on clinical and pharmaceutical therapies. Normal central nervous system (CNS) function has been associated

with healthy gut function. It is recognized that hormones, neurotransmitters, and immunological elements secreted from the gut can communicate with the brain directly or through autonomic neurons. Nonetheless, the "body-mind" connection has long been acknowledged in Ayurveda. From the very beginning of the Vedic era, attempts were made to investigate the mind from a scientific standpoint. Role of nutrition in healthy mind is one of the most undervalued concepts in psychiatry. Brain requires different amounts of complex carbohydrates, essential fatty acids, amino acids, vitamins, minerals and water to remain healthy. In order to reduce the prevalence of mental disorders, an integrated approach which synchronously reflects the interplay of biological, psychological, spiritual and social aspects of Psychiatry is needed. Every living and non-living beings in this universe is composed of five basic elements, the Pancha Mahabhootas, namely Earth (Prithvi), Water (Ap), Fire (Teja), Air (Vayu) and Ether (Akasha) the Pancha Bhuta components of ingested food nourish their respective tissue elements in the body. Ahara is the best of all medicines and is considered one among the three sub-pillars of Ayurveda (Thrayo-Upasthamba). This paper emphasizes the value of indigenous diets in treating contemporary psychological issues by drawing on old knowledge systems and new scientific findings. Combining modern nutrition and mental health techniques with ancient food knowledge may provide creative approaches to improve wellbeing in a variety of demographics.

Keywords: *Indigenous dietary practices, psychological wellness, mental health, traditional food systems, gut-brain axis, ayurvedic food, cognitive health, cultural nutrition.*

Adverse impact of Stubble burning and alternate solutions

Arumita Nayak
Department of Agronomy, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal-736165

Abstract

Stubble burning is one of the major contributors of air pollution. In rice-wheat system, stubble burning is an annual crisis. After harvesting rice, farmers rapidly burn left-over residues to clear fields to sow subsequent wheat in a narrow window. In India, 178 million metric tons of leftover plant matter each year meet only fire. Stubble burning releases particulate matter, carbon monoxide, Sulphur dioxide, methane heavily deteriorating air quality and leads to global warming. It makes an immediate and long-term impact in the soil fertility. Beside this stubble burning creates a major impact on human health. To overcome this problem, it's advisable to use happy seeder, super seeder, multi crop planter which sows seeds in rows directly on residue of previous crop. The use of bio decomposer can accelerate the decomposition of organic waste to useful compost. Other alternate solution to overcome this problem are use of advanced agricultural machineries like paddy straw chopper, reaper binder, combine harvester with straw management system. Burning stubble is like burning your own money, because farmers can use that stubble for multiple purposes mushroom cultivation, composting, cattle bedding, mulching, bedding materials and more instead of getting just one short-term benefit from burning. We should move with the slogan "Don't burn it, earn from it Stubble is wealth, not waste".

Constrains faced by the farmers in implementing the scheme SMAM and suggest strategies to overcome constrains for smooth functioning the scheme SMAM

[1]Avirup Das, [2]Dr. Sukanya Barua, [3]Dr.Kabita Mondal, [1]Atreyee Sarkar

[1]PhD Scholar, Department of Agricultural Extension, Uttar Banga Krishi Viswavidyalaya, Pundibari, Coochbehar-736165

[2]Scientist, Division of Agricultural Extension, Indian Agricultural Research Institute, Pusa, New Delhi, Delhi 110012

[3]Department of Agricultural Extension, College of Agriculture, Uttar Banga Krishi Vishwavidyalaya, Majhian, Dakshin Dinajpur 733133

Corresponding author e-mail: avirupdas260@gmail.com

Abstract

The successful implementation of the Sub-Mission on Agricultural Mechanization (SMAM) is often influenced by various socio-economic, institutional, and technical constraints faced by farmers. The present study was conducted in the aspirational districts of Nadia and Birbhum in West Bengal to identify and prioritize the major constraints affecting the implementation of SMAM. A total of 160 farmers were selected through random sampling from four villages across Haringhata and Bolpur Sriniketan blocks. Data were collected through personal interviews and analysed using the Garrett Ranking Technique. The findings revealed that among awareness and capacity-related constraints, lack of awareness about the SMAM scheme and its benefits emerged as the most severe constraint, followed by limited knowledge of the application process and eligibility criteria. In the institutional and infrastructure domain, inadequate after-sales service and poor availability of spare parts were identified as the most critical barriers, while poorly managed Custom Hiring Centres also posed significant challenges. Regarding financial and economic constraints, the high cost of operating large machinery on small and fragmented landholdings was ranked as the foremost problem, followed by the high purchase cost of machinery even after receiving subsidies. To address these challenges, suitable strategies were prioritized using the Analytical Hierarchy Process (AHP). The most important recommendations included conducting regular awareness campaigns at village and block levels, promoting small and multi-functional farm machinery suited to small landholdings, and increasing the number of Custom Hiring Centres to improve machinery accessibility. Establishing mobile repair units and simplifying subsidy disbursement procedures were also identified as effective interventions. The study highlights the need for targeted policy measures, strengthened extension efforts, and improved institutional support to overcome the constraints associated with SMAM. Addressing these barriers can enhance the adoption of agricultural mechanization and improve the productivity and livelihoods of small and marginal farmers in the aspirational districts of West Bengal.

Keywords: *Agricultural mechanization; SMAM; Constraints; Garrett ranking; AHP; Small and marginal farmers; Aspirational districts; West Bengal.*

Assessing The Technical Efficiency of Rabi Paddy Production in West Bengal: A Stochastic Frontier Analysis

Bharat Kumar Marmat[1*] and Manoj Kanti Debnath[2]

[1]Ph.D. Research Scholar, Department of Agricultural Statistics,

[2]Assistant Professor, Department of Agricultural Statistics,
Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal-736165
Corresponding author e-mail id: bharatmarmat10@gmail.com

Abstract

Paddy is major food crop in West Bengal and improving its production efficiency is essential for ensuring food security and enhancing farmers' incomes. This study evaluates the technical efficiency of rabi paddy production in West Bengal through a Stochastic Frontier Analysis (SFA), based on unit-level data extracted from the National Sample Survey Organisation (NSSO) 77th Round (Schedule 33.1). Based on a sample of 1290 paddy-farming households, Maximum Likelihood Estimation was employed to estimate and compare Cobb-Douglas and Trans-log frontier production functions. A Likelihood Ratio (LR) test confirmed that the Trans-log production model is statistically superior and provides a better fit to the data. The estimated variance parameter (ã) was found to be 0.998, which is statistically significant at the 1% level, suggesting that all variation in rabi paddy output from the frontier is attributable to farm-specific technical inefficiencies rather than random environmental shocks or statistical noise. The empirical results revealed a mean technical efficiency of 81.1% under the preferred Trans-log model, indicating that rabi paddy production could potentially be increased by 18.9% if farmers operated on the maximum production frontier. Furthermore, district-wise technical efficiency estimates indicated that Darjeeling had the highest technical efficiency score (87.8%), whereas Howrah had the lowest (69.9%). Moreover, an inefficiency effect model was used to examine the influence of various socio-economic factors, including age, gender, education, household size, farm size, credit access, crop insurance, irrigation ratio, and access to technical advice. However, these variables were found to be statistically non-significant, suggesting that the observed variation in technical inefficiency among the agricultural households cannot be adequately explained by the selected factors. This may indicate a high degree of homogeneity in farming practices or the influence of unobserved regional and biophysical constraints.

Keywords*: Cobb-Douglas production function, Likelihood Ratio, Maximum Likelihood Estimation, Stochastic Frontier Analysis, Technical Efficiency, Trans-log production function.*

Screening of Rice Genotypes for Maintainer and Restorer Ability in Hybrid Rice Development

Bipul Barman[1*], Bidhan Roy[2], Utpal Maity[3]
Department of Seed Science and Technology, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal, 736165
***Corresponding author e-mail: bipulbarman22.bb@gmail.com**

Abstract

Hybrid rice plays a crucial role in enhancing rice productivity and ensuring food security, particularly in countries with increasing population pressure and limited cultivable land. Despite considerable progress in hybrid rice breeding, the identification of stable and efficient maintainer and restorer lines remains a major challenge. The investigation focused on the identification of effective maintainer and restorer lines for CMS-based hybrid rice breeding. In the present investigation, 36 test hybrids were generated by crossing four CMS lines with nine rice genotypes following a line × tester mating design. Based on spikelet fertility estimates, the 36 hybrids were classified as 5 restorers, 17 partial restorers, 14 partial

maintainers, and zero maintainer. The promising restorers identified in the present study may be utilized for developing superior hybrid rice combinations.

Keywords*: Hybrid rice, crossing, line x tester, restorer, maintainer*

Performance of organic-inorganic nutrient combinations on crop productivity and soil bio-physical quality under vetiver based intercropping systems

Kasturi Ghosh[1], Chandan De[2*], Takbir Ali[2], Sukamal Sarkar[3], Babulal Mahato[4], Koushik Brahmachari[2], Mahadev Pramanick[2]

[1]Assistant Director of Agriculture, WBAS (Admn.), Udaynarayanpur block, Howrah, West Bengal
[2]Department of Agronomy, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal
[3]Division of Agronomy, School of Agriculture and Rural Development, Ramakrishna Mission Vivekananda Educational and Research Institute, Kolkata, India
[4]Additional District Magistrate (LA), Prashasan Bhavan, Suri, Birbhum, West Bengal
[*]***Corresponding author e-mail: chandande1999@gmail.com***

Abstract

Soil erosion is emerging as a major threat to agricultural production, leading to substantial losses of fertile topsoil, nutrients and soil organic matter. Vetiver (*Chrysopogon zizanioides*), owing to its deep and dense fibrous root system, has gained attention as an effective biological tool for erosion control and soil-water conservation. Therefore, a field experiment was conducted during April to December of two consecutive years (2021 and 2022) at District Seed Farm (C Unit), BCKV, Kalyani, to standardize a cost effective, eco-friendly vetiver based intercropping system integrated with nutrient management practices for enhancing productivity and soil-water conservation in New Alluvial Zone of West Bengal. The experiment was laid out in split-plot design, comprising three vetiver-based cropping systems *i.e.* sole vetiver, vetiver + baby corn and vetiver + cowpea (1:1 row ratio) in main plot and six nutrient management practices in subplots: 100% chemical fertilizer ($N:P_2O_5:K_2O$ @60:25:25); 75% chemical fertilizer + 25% organic manure; 50% Chemical fertilizer + 50% organic manure; 25% chemical fertilizer + 75% organic manure; 100% organic manure (vermicompost) and control. Results revealed that vetiver-cowpea intercropping system under 100% organic manure recorded the highest root yield (3159.82 kg/ha), oil yield (30.14 kg/ha) and harvest index (42.06%), with significant improvement in microbial population, soil aggregation and water holding capacity. However, vetiver–baby corn under 25% chemical + 75% organic manure achieved the maximum straw yield (5224.96 kg/ha) and system productivity (34.86 kg/ha). Moreover, vetiver-cowpea with full organic inputs minimized soil loss (0.085 t/ha, as predicted through APSIM), increased available NPK and improved overall soil health over the two-year cropping cycle. The same treatment recorded the highest net return (₹ 135,907.35 ha^{-1}) with B:C ratio of 3.41. Thus, vetiver–cowpea intercropping under 100% organic manure was found most effective, offering a sustainable, resource conserving and economically viable strategy for farmers in New Alluvial Zone of West Bengal.

Keywords: *Vetiver-intercropping, Cowpea, Baby corn, Integrated nutrient management, Erosion mitigation.*

Crop production technology and precision agriculture

Chetna Pathak[1*], Abhijeet Kuderiya[2]
[1&2] PhD Scholar, Jawaharlal Nehru Krishi Vishwavidyalaya, Jabalpur – 482004 - (M.P.), India.
Corresponding author email address: csapathak@gmail.com

Abstract

Crop production technology and precision agriculture are transforming modern farming systems by enhancing productivity, profitability, and environmental sustainability. Traditional crop production practices often rely on uniform application of inputs such as seeds, fertilizers, water, and pesticides across entire fields, which may lead to inefficiencies and resource wastage. Precision agriculture addresses these challenges through the integration of advanced technologies including Global Positioning System (GPS), Geographic Information System (GIS), remote sensing, Internet of Things (IoT), drones, artificial intelligence (AI), robotics, and data analytics. These tools enable site-specific crop management by monitoring spatial and temporal variability in soil health, moisture status, nutrient availability, pest incidence, and crop growth conditions. The adoption of precision crop production technologies helps farmers optimize input use efficiency, reduce production costs, improve crop yield, and minimize environmental degradation. Smart irrigation systems, variable rate technology (VRT), automated machinery, and sensor-based nutrient management contribute to sustainable intensification of agriculture. Furthermore, precision agriculture enhances climate resilience by enabling timely decision-making under changing weather conditions and resource constraints. Real-time data collection and predictive analytics assist in selecting suitable crop varieties, determining sowing dates, and managing risks related to drought, floods, and pest outbreaks. Despite its significant potential, the adoption of precision agriculture remains constrained by factors such as high initial investment, lack of technical knowledge, inadequate rural connectivity, and limited access for smallholder farmers. Capacity building, digital infrastructure development, and supportive government policies are essential to scale up these technologies. Collaborative efforts among researchers, extension agencies, agribusiness firms, and policymakers can accelerate the transition toward technology-driven agriculture. In conclusion, crop production technology combined with precision agriculture offers a pathway to achieve higher productivity, efficient resource utilization, and sustainable food systems. It is a key strategy for meeting the growing global food demand while conserving natural resources and ensuring long-term agricultural sustainability.

Keywords: *Crop production technology, Precision agriculture, Smart farming, GIS, Remote sensing, IoT.*

Emerging Tea Pathogens in Northern West Bengal: Characterization and Management of *Clonostachys* spp. and *Lasiodiplodia* spp.

Claribel Grace Pradhan[1*], Anamika Debnath[1], Prateek Madhab Bhattacharya[1], Ayon Roy[1]
[1]Department of Plant Pathology, Uttar Banga Krishi Viswavidyalaya (UBKV), Pundibari, Coochbehar-736165
Corresponding author e-mail: claribelpradhan@gmail.com

Abstract

Changing environmental conditions are influencing the emergence and spread of fungal diseases in tea-growing regions, threatening tea productivity and sustainability. During disease surveys conducted

across northern West Bengal, several pathogens associated with different disease symptoms were isolated and studied. This study focuses on two emerging disease issues: leaf blight caused by *Clonostachys* spp. and dieback caused by *Lasiodiplodia* spp. Symptomatic samples were collected, pathogens were isolated and characterized, and pathogenicity tests confirmed their disease-causing ability. Morphological and molecular analyses identified the pathogens as *Clonostachys eriocamporesiana*, *Clonostachys rosea*, *Lasiodiplodia theobromae, Lasiodiplodia lignicola,* and *Lasiodiplodia pseudotheobromae*. Representative sequences were deposited in GenBank. Among the fungicides tested, Azoxystrobin 18.2% + Difenoconazole 11.11% was most effective against *Clonostachys* sp. (ED 50 • < 0.001 ppm), while Difenoconazole 25% EC showed the lowest ED 50 • values against *L. pseudotheobromae* (0.55 ppm) and *L. theobromae* (0.02 ppm). In dual culture assays, *T. asperellum* showed the highest inhibition against *Clonostachys* sp., whereas *T. harzianum* was most effective against *L. pseudotheobromae* and *L. theobromae*.

Keywords: *Tea diseases, Clonostachys spp., Lasiodiplodia spp., emerging pathogens, fungicide sensitivity, Trichoderma*

Integration of organic manure, compost and biofertilizers to inorganic fertilizers improved yield of dragon fruit

Debashis Mandal and R.C. Lalduhsangi

Department of Horticulture, Aromatic & Medicinal Plants, Mizoram University, Aizawl-796004, Mizoram, India.

Abstract

A field experiment was conducted at Farmer's Field, Ailawng Village, Mamit district, Mizoram to check the effect of two organic manures viz. Farm Yard Manure (FYM) and Neem Cake (NC), one compost i.e. Vermi Compost (VC) and three different biofertilizers viz. Azotobacter (AZ), Phosphate Solubilizing Bacteria (PSB) and Potash Solubilizing Bacteria (KSB) along with inorganic fertilizers (urea, single super phosphate and muriate of potash) on red fleshed dragon fruits planted with a spacing of 4m X 2m among pillars and 3 plants per pillar with 13 treatments and three replications laid out at randomized block design. Different parameters on plant growth, fruit growth, fruit physical and biochemical parameters, yield and soil minerals were recorded. Results from the trial for two consecutive years revealed that high cladode length (295.67 cm), cladode circumference (22.44 cm), number of cladodes per plant (20.67), number of fruits per pillar (23.67) and yield (10.39 tons ha^{-1}) was recorded for the treatment (T_8) with 50% recommended dose of fertilizer (RDF) through inorganic fertilizers along with 25 % potassium equivalent of RDF through FYM, 25 % potassium equivalent of RDF through VC and biofertilizer complex (AZ+PSB+KSB). Highest fruit weight (351.17g), fruit diameter (89.83 mm), TSS (13.15^0 Brix), TSS:acid ratio (69.21), total sugar (8.81%) and pulp anthocyanin content (13.97 mg $100g^{-1}$) was found under the same treatment. However, fruit physico-chemical quality was also found good under T_5 (FYM to supply 50% K+ 50% RDF+ AZ+PSB+KSB) and yield was also high (9.82 tons ha^{-1}) under T_{12} (FYM to supply 25% K+ VC to supply 25% K+ NC to supply 25% K + 25% RDF+AZ+PSB+ KSB).

Keywords: *biofertilizers, dragon fruit, farm yard manure, neem cake, physico-chemical, vermi compost*

Identification, Characterization and Evaluation of Antagonistic Potential of Various Fluorescent Pseudomonads of Northern Part of West Bengal

Debnath A., Saha R., Roy A. And Bhattacharya P.M.
Department Of Plant Pathology, Uttar Banga Kishi Viswavidyalaya, Pundibari, Cooch Behar
E-mail: dr.anamikadebnath@rediffmail.com & anamikamam.cob@gmail.com

Abstract

The characterization of various bacterial isolates from soil samples in the different regions of West Bengal was studied to assess their potential impact on the crop health of lentil and tomato. Based on biochemical characterization, including carbohydrate utilization (e.g., D-glucose, D-galactose, D-fructose, L-arabinose, D-xylose, L-rhamnose, sucrose, maltose, lactose, cellobiose, starch, cellulose, sorbitol, and mannitol) and citrate utilization, most isolates tested positive. Additionally, most isolates exhibited catalase and oxidase activity and the ability to produce hydrogen cyanide (HCN). The isolates were identified as members of the Pseudomonas group. Growth studies across various temperatures and pH levels showed increased growth with higher temperatures and pH levels, with reduced growth at pH 8. Selected isolates were applied in field trials with lentil and tomato crops, and their effects on germination percentage, root and shoot length, days to flowering, yield, and disease incidence were assessed. Among these, the PF17 isolate demonstrated the best performance. Molecular sequencing identified PF17 as *Pseudomonas protegens*, with a 99.25% similarity based on 16S rDNA nucleotide homology and phylogenetic analysis. *In vivo*, PF17 was found to be the most effective isolate for further exploration

Keywards: *Pseudomonads, biochemical characterization, antimicrobial properties, In-vivo efficacy*

Integrated Use of Rhizobium, Azotobacter and PSB for Managing Fusarium Wilt of Chickpea

Dinesh H. Chaudhary[1*], Manjula. G. Chaudhari[2] and Bharat A. Chaudhary[3]
[1,2]Assistant Professor, Navsari Agricultural University, Navsari
[3]Assistant Research Scientist, Navsari Agricultural University, Navsari
****Corresponding author e-mail: dhchaudhary@nau.in***

Abstract

Fusarium wilt of chickpea, caused by *Fusarium oxysporum* f. sp. *ciceri*, is a persistent soil-borne disease that limits crop productivity due to its long-term survival in soil. Biofertilizers such as *Rhizobium*, *Azotobacter* and phosphate-solubilizing bacteria (PSB) provide an effective biological approach for disease suppression and plant growth promotion. Field studies reveal that seed treatment with *Rhizobium* and *Azotobacter* @ 25 g/kg seed and PSB @ 15 g/kg seed, along with soil application of 4 kg/ha biofertilizer cultures enriched in 75 kg FYM, significantly enhances plant health. Individual application of these biofertilizers results in 45.60% reduction in disease incidence, while combined inoculation achieves 62.15% suppression of Fusarium wilt. This integrated approach increases plant survival by 35% and reduces plant mortality by 60% over untreated control. In addition, biofertilizer application improves nodulation by 50%, root biomass by 30% and nutrient uptake by 20%, leading to enhanced crop performance with a 30% increase in grain yield.

Keywords: *Fusarium wilt, chickpea, Rhizobium, Azotobacter and PS bacteria*

Integrated Eco-Friendly Management of Collar Rot in Groundnut Using Bioagents and Botanicals

Dinesh H. Chaudhary[1]*, H. K. Chaudhary[2] and Lala S. Chaudhary[3]
[1]Assistant Professor, Navsari Agricultural University, Navsari
[2]Agriculture Officer, NMCA, Navsari Agricultural University, Navsari
[3]Ph. D (Scholar), Dept. of Entomology, NMCA, Navsari Agricultural University, Navsari
Corresponding author e-mail: dhchaudhary@nau.in

Abstract

Collar rot of groundnut caused by *Aspergillus niger* is a major soil-borne disease affecting crop establishment and productivity. A field study evaluated integrated eco-friendly management using seed treatment with *Trichoderma harzianum* at 10 g kg{ ¹ seed, soil application of *T. harzianum* at 2.5 kg ha{ ¹ enriched in 50 kg FYM, neem cake at 500 kg ha{ ¹ and foliar spray of neem seed kernel extract at 5%. The integrated treatment combining seed treatment + soil application of *Trichoderma* + neem cake reduced collar rot incidence by 65.33% and increased pod yield by 30.78% over untreated control. Integration of bioagents, botanicals and organic amendments offers an effective, eco-friendly and sustainable strategy for managing collar rot in groundnut while reducing dependence on chemical fungicides.

Keywords: *Collar rot, Groundnut, Aspergillus niger and Trichoderma harzianum*

Computational Identification of Natural Phytochemical Inhibitors Against á-Glucosidase for Type 2 Diabetes Mellitus Control

Dr. Paushali Pal
Assistant Professor, Sri Shakthi Institute of Engineering and Technology, Coimbatore, Tamil Nadu, India.
E-mail: palpaushali@gmail.com

Abstract

Type 2 Diabetes Mellitus is a major metabolic disorder characterised by persistent hyperglycemia and impaired glucose metabolism. á-glucosidase is a key enzyme involved in the final stage of carbohydrate digestion, making it an important therapeutic target for controlling postprandial blood glucose levels. Natural phytocompounds have gained increasing attention as safer alternatives to synthetic anti-diabetic drugs. In the present study, Feruperine and Quercetin were evaluated as potential á-glucosidase inhibitors using computational approaches. Virtual screening was performed using Dr. Duke's Phytochemical and Ethnobotanical Databases. Molecular docking analyses were conducted using PyRx and SwissDock, while binding pocket and interaction analyses were performed using PyMOL and UCSF Chimaera. Molecular dynamics simulation and Normal Mode Analysis were performed using the iMODS server. ADMET prediction was performed using ADMETlab 3.0 to evaluate pharmacokinetic and toxicity profiles. The selected phytocompounds demonstrated favourable binding affinity and stable interaction profiles against á-glucosidase. Important active site residues, including GLU196, GLU579, TYR609, ARG608, GLY359, and LYS195, contributed to ligand stabilisation within the catalytic pocket. Molecular dynamics analyses indicated acceptable conformational stability and flexibility of the docked complexes. ADMET prediction further suggested favourable drug-likeness, pharmacokinetic suitability, and

acceptable toxicity profiles of the compounds. The present study suggests that Feruperine and Quercetin possess promising potential as natural á-glucosidase inhibitors for the management of Type 2 Diabetes Mellitus. Their favourable binding affinity, interaction stability, and pharmacokinetic properties support their possible therapeutic application. However, further experimental validation through in vitro and in vivo studies is required to confirm their anti-diabetic efficacy.

Keywords: *á-glucosidase; Type 2 Diabetes Mellitus; Feruperine; Quercetin; Molecular Docking; Phytocompounds*

Climate Resilience, Mitigation and Adaptation: Sustainable Peace Environment in The Twenty First Century

Dr. Munna Lal Yadav
Head of Department, Defence and Strategic Studies, R.K. P.G. College, Amethi,
Dr. Ram Manohar Lohia Avadh University Ayodhya U.P.

Abstract

The South Asian region's volatile geological situation and high degree of mutual mistrust and the potential for environmental degradation to trigger events means environmental factors could become a major cause of instability and threat to South Asian security. This region comprises of seven adjacent countries-India, Pakistan, Sri Lanka, Bhutan, Nepal, Maldives and Bangladesh. The region has many interstate rivers and common sea coastline extending from Pakistan in the West to Bangladesh in the East. Five of them share land borders with India except the island nations of Sri Lanka and Maldives. Bhutan and Nepal are land locked nation. This geographic contiguity is separated by geo-political rivalries and security concerns between the different political units, whose political system run from a well established and deeply rooted democracy in India, to an inexperienced one in Bangladesh, uncertainty in Nepal, through monarchy in Bhutan and to military dictatorship/unstable democracy in Pakistan. Internally, these nations are struggling with their own internal problems.

Response of different tomato genotypes to varied doses of Orthosilicic acid

Sudipto Ghosh[1], Sayan Sau[2*], Arindam Das[3] and Manas Kumar Pandit[1]
[1]Department of Vegetable Science, Faculty of Horticulture, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal 741252, India
[2]Hooghly Krishi Vigyan Kendra, Bidhan Chandra Krishi Viswavidyalaya, Chinsurah, West Bengal 712102, India
[3]Department of Vegetable and Spice Crops, Faculty of Horticulture, Uttar Banga Krishi Viswavidyalaya, Pundibari, CoochBehar, West Bengal 736165, India
Corresponding author's Email: hortsayan17rs@gmail.com

Abstract

The need for proper silicon (*Si*) management to increase yields and sustain crop productivity seems essential for both temperate and tropical countries. *Si* absorption in the plants of same species varied due to genotypic differences in ability of absorption of MSA (Monosilicic Acid) by roots of different plants. Considering the above facts, the present investigation has been carried out at the Horticultural Research Station, Mondouri, B.C.K.V, Nadia, West Bengal, India during 2019-20 and 2020-2021 with

6 indeterminate popular F_1 hybrid variety of tomato and 4 different OSA (Orthosilicic acid) dose combinations subjected to two-factor RBD with three replications. Results of the experiment showed that the variety PAN 1286 superseded all the other entries significantly for almost all the growth and yield characters, except stem thickness and similarly, Orthosilicic acid @ 2500 ml / ha (i.e., 3.5ml/lit of water) dose was found to be best among silicon treatments. Lower days to 1st and 50% flowering both profitably contributed to widen the fruiting window. The lowest AUDPC (area under the disease progress curve) was recorded in variety Heemsohna with 3500 ml/ha of Orthosilicic acid, which was closely followed by PAN 1286 with 3500 ml/ha of Orthosilicic acid. Maximum leaf and root dry weight was recorded from the variety in the treatment combination of PAN 1286 with 2500 ml/ha of Orthosilicic acid (V3D2) and the same combination also resulted in maximum B:C ratio of 3.67.

Keywords: *Silicon, Tomato, Genotypic difference, Growth and Yield parameters, B:C ratio*

Ensemble Synergistic Artificial Neural Network (ES-ANN) with Inclusive Multiple-Model Strategy for Evapotranspiration Prediction Across Diverse Hydro-Climatic Regions

Himadri Shekhar Roy[1*], Ranjit Kumar Paul[1], Md. Yeasin[1], Prakash Kumar[1]
[1]ICAR- Indian Agricultural Statistics Research Institute Library Avenue, Pusa, New Delhi-110012
Corresponding author: himadriiasri@gmail.com

Abstract

Accurate estimation of evapotranspiration (ET) is essential for hydrological modelling, irrigation scheduling, and climate-adaptive water-resource management, particularly across India's diverse river basins. Traditional artificial neural networks (ANNs) often underperform in such heterogeneous hydro-climatic environments due to the limitations of gradient-based optimization, including slow convergence and susceptibility to local minima. To address these challenges, this study proposes an Ensemble Synergistic Artificial Neural Network (ES-ANN) framework incorporating multiple hybrid and standalone ANN models optimized using evolutionary algorithms—Genetic Algorithm (GA), Particle Swarm Optimization (PSO), Firefly Algorithm (FFA), and Cuckoo Search (CS). An Inclusive Multiple-Model (IMM) strategy is applied to fuse first-level model outputs and enhance robustness. The model was evaluated across two climatic locations using temperature, humidity, rainfall, and solar radiation data.

The findings confirm that all evolutionary-optimized models consistently outperform the baseline ANN across both climatic locations, with the IMM ensemble strategy yielding the highest predictive accuracy and generalization capability. The ES-ANN framework with IMM demonstrates marked superiority in capturing the complex, non-linear dynamics of ET processes, offering a robust and reliable data-driven solution for ET modelling and water-resource optimization.

Keywords: *Evapotranspiration · Ensemble Synergistic ANN (ES-ANN) · Inclusive Multiple Models (IMM) · Evolutionary Optimisation · Hydrological Modelling · Water Resource Management*

Integrated Framework for Genomic Selection Informed by GWAS and Ecological Variation

Prakash Kumar[1], Himadri Shekhar Roy[1]*, Niraj Budhalakoti[1], Amrit Kumar Paul[1], Paresh Chaukhande[2], Ranjit Kumar Paul[1], Md. Yeasin[1]
[1]ICAR-Indian Aricultural Statistics Research Institute, New Delhi-110012

[2]ICAR-Indian Aricultural Research Institute, New Delhi-110012
Corresponding author: himadriiasri@gmail.com

Abstract

This study presents an integrated statistical framework combining genome-wide association studies (GWAS), genomic selection (GS), reaction norm modelling, and genotype-by-environment interaction (G×E) analysis for genetic improvement in potato (*Solanum tuberosum* L.). A panel of 192 genotypes evaluated across three environments in India was analysed using adjusted genotype means (BLUEs) from augmented block design trials. A novel EM-based Bayesian Adaptive LASSO Variational Inference (emBALVI) approach identified 82 significant SNPs from 11,233 markers, confirming the polygenic nature of the trait. GWAS-informed markers were used to construct a genomic relationship matrix for prediction. Among the models tested, rrBLUP showed the highest and most stable predictive accuracy (r = 0.717), followed closely by BGLR (r = 0.713), while Random Forest showed moderate performance (r = 0.615). Incorporating ecological covariates (rainfall and temperature) within a reaction norm framework enabled partitioning of genetic and G×E variance, improving prediction across environments.

Keywords: *Genomic selection; GWAS; genotype-by-environment interaction; emBALVI; rrBLUP; BGLR; reaction norm; ecological covariates; potato breeding; Bayesian genomic prediction*

Evaluation of F1 hybrida of selected crosses of gladiolus

Himangshu Barman[1]* Arpita Mandal Khan[2]

[1]M.Sc., Department of Floricultural Medicinal and Aromatic Plants, Faculty of Horticulture, Uttar Banga Krishi Vishwavidyalaya (UBKV), Pundibari, Cooch Behar, West Bengal, India.
[2]Department of Floricultural Medicinal and Aromatic Plants, Faculty of Horticulture, Uttar Banga Krishi Vishwavidyalaya (UBKV), Pundibari, Cooch Behar, West Bengal, India.
Correspondence author's E-mail: barmanh9333@gmail.com

Abstract

Gladiolus grandifloras L., commonly known as sword lily, is one of the most important cut flowers worldwide and is often referred to as the "Queen of bulbous crops" due its attractive spike and wide adaptability. The main emphasis in improvement of gladiolus is on development of hybrids through hybridization in because of its distinct qalitative and quantitative characters. In this background hybridization programme was taken up and a full diallel cross of 9 selected cultivars of gladiolus was performed in year 2025. The seeds were collected and grown in first year to obtain corms and cormels. In the next season the corms and cormels were grown under polyhouse. The performance of F1 hybrids of selected 3 crosses *viz.* Arka Kesar × Pusa Red Majesty, Arka Pratham × Arka Naveen, Arka Kesar × Arka Naveen was evaluated during 2026. The variation in plant height was ranged within 75.5cm to 76.3cm. The leaf length was maximum (71.25cm) in Arka Pratham × Arka Naveen, whereas it was least in Arka Kesar × Punjab Lemon Delight. While rachis length was significantly high in Arka Kesar × Pusa Red Majesty, in Arka kesar × Arka Naveen it was only 43.8cm long. No significant variation was noted in number of flowers per spike. Weight of flower ranged from 2.5gm to 2.78 gm and the diameter of flower (horizontal &vertical) ranged from 9.27cm to 10.3cm. The main colour of flower varied from pink to mauve, violet, yellow, red and white with striking variations in floret arrangement, orientation, secondary colour of macule and markings of the petals. The results of the study can lead to selection of promising hybrids of gladiolus after further evaluation and multiplication.

***Keywords**: Hybridization, Gladiolus, F1 hybrids, Evaluation, Variation, Cormels*

ZnO Nanoparticle-Mediated Improvement of Photosystem II Efficiency and Chlorophyll Stability in Linseed Under Drought and High temperature Stress

***Himanshu Mehra, Sunder Singh Arya**
Department of Botany, Maharshi Dayanand University, Rohtak
Email-himanshumehra401@gmail.com

Abstract

Linseed (*Linum usitatissimum* L.) is an important oilseed crop whose productivity is increasingly threatened by drought and high-temperature stress, particularly during critical growth stages. These abiotic stresses adversely affect photosynthetic efficiency by disrupting chlorophyll biosynthesis, accelerating pigment degradation, and impairing the functioning of photosystem II (PSII). Use of nanoparticles (NPs) can serve as effective stress-mitigating agents due to their high surface area, enhanced bioavailability, and role in physiological and biochemical processes. Current study investigates the potential of ZnO-NPs to alleviate the detrimental effects of drought and high-temperature stress in linseed. The foliar application of nanoparticles was applied at concentrations (50 ppm and 100 ppm) to three linseed varieties (LSL-93, 1297A, and T397) subjected to drought stress (20% polyethylene glycol [PEG-6000]) and high temperature (HT) stress. High temperature and drought stress leads to oxidative damage in plant leading to reduced photosynthetic pigment and photosynthetic efficiency (Fv/Fm). However, application of ZnO-NPs improves the chlorophyll content and Fv/Fm which were reduced under high temperature and drought stress, by promoting chloroplast stability and reducing oxidative damage. Furthermore, ZnO NP-treated plants exhibited reduced photoinhibition, improving plant growth These findings highlight the potential of ZnO nanoparticles as a sustainable strategy for mitigating the adverse effects of combined drought and heat stress in linseed, thereby improving photosynthetic efficiency and supporting crop productivity under changing climatic conditions.

***Keywords:** Nanoparticles, linseed, Fv/Fm, polyethylene glycol, high temperature and ZnO*

Climate-Smart Vegetable Farming and Extension Innovations for Livelihood Security in Eastern Himalayan Farming Systems

J Tamal Atab[1]*
[1]Ph.D Research Scholar, School of Development Studies, Tata Institute of Social Sciences, Deonar, Mumbai-388001, Maharashtra, India
****Corresponding and Presenting author: jtamalatab15@gmail.com***

Abstract

Eastern Himalayan farming systems, encompassing Sikkim's organic landscapes and the Terai and northern West Bengal's conventional agricultural zones, form a fragile interface of agro-ecological diversity, climate vulnerability, and smallholder livelihoods. Escalating climatic variability, characterised by erratic monsoons, rising temperatures, and shifting cropping calendars, poses unprecedented threats to vegetable production and rural livelihood security in these ecologically sensitive regions. Despite their strategic importance, empirical evidence on climate-adaptive farming practices and the role of extension innovations in building livelihood resilience remains critically inadequate.

This paper examines the intersection of climate-smart agriculture, extension system effectiveness, and livelihood outcomes among vegetable farmers in the Eastern Himalayas, drawing from ongoing PhD research comparing organic potato farming in Sikkim with conventional vegetable cultivation in West Bengal. Anchored in Rogers' Diffusion of Innovations theory and the Sustainable Livelihoods Approach (Chambers & Conway, 1992), the study explores how formal, informal, and ICT-mediated extension services facilitate the adoption of climate-resilient practices, including crop diversification, conservation agriculture, organic input management, and participatory technology transfer.

Preliminary insights reveal that while Sikkim's state-led organic mission has institutionalised low-external-input systems with inherent climate co-benefits, structural constraints in extension outreach, knowledge gaps, and inadequate market integration continue to limit farmer adaptive capacities. Conventional farming zones in northern West Bengal, though more productive, remain ecologically vulnerable and dependent on chemical-intensive systems susceptible to climatic shocks. The paper advocates region-specific, gender-responsive extension innovations that integrate climate intelligence with community-led livelihood strategies, particularly through Farmer Producer Organisations and digital agricultural advisory platforms.

The findings contribute to policy discourse on designing adaptive and inclusive extension frameworks for Eastern Himalayan agricultural systems, with direct implications for livelihood security, food sovereignty, and ecological resilience.

Keywords: *Climate-smart agriculture, extension innovations, Eastern Himalayan farming, livelihood security, organic farming, vegetable production*

Harnessing Cold Stress Tolerance in Aphidophagous Coccinellids for Augmentative Biological Control

Jeyashree J[1*], Suprakash Pal[2]

[1]Department of Agricultural Entomology, Uttar Banga Krishi Viswavidyalaya (UBKV), Pundibari, Cooch Behar, West Bengal-736165, India.

[2]Directorate of research (RRS- TZ), Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal-736165, India.

Corresponding author e-mail: jeyashreejeyaselvan@gmail.com

Abstract

Cold stress is an important abiotic factor influencing the survival and performance of beneficial insects used in biological control programmes. Understanding the tolerance of natural enemies to low-temperature stress is essential for improving their storage, transportation, and field deployment. This study evaluated the effects of cold storage at 6°C on the survival and developmental performance of two aphidophagous coccinellids, *Cheilomenes sexmaculata* (Fabricius) and *Coccinella transversalis* Fabricius, fed on *Myzus persicae* (Sulzer).

Eggs, pupae, and 10-day-old adults of both species were exposed to cold storage for 3, 7, 14, 21, and 28 days. Egg hatchability, adult emergence from pupae, and adult survival were assessed after each storage period. Egg hatchability was significantly reduced by prolonged cold storage, reaching 51.0% and 63.5% in *C. sexmaculata* and *C. transversalis*, respectively, after 7 days. No successful egg hatch was observed beyond 14 days. Pupal emergence remained unaffected up to 3 days of storage (100%) but

declined after 7 days to 88.0% and 98.0% in *C. sexmaculata* and *C. transversalis*, respectively. No successful adult emergence occurred beyond 14 days. In contrast, adults exhibited greater tolerance to low-temperature stress and survived considerably longer under refrigerated conditions than under ambient conditions. Among the two species, *C. transversalis* consistently demonstrated superior cold tolerance, exhibiting higher egg hatchability, pupal emergence, and adult survival than *C. sexmaculata* across all storage durations.

The results indicate that eggs and pupae of both species can be stored successfully for up to 7 days at 6°C, whereas adults are more suitable for extended storage. The greater cold stress tolerance of *C. transversalis* highlights its potential for mass rearing, storage, transportation, and augmentative biological control programmes. These findings contribute to the development of efficient and sustainable biological control strategies for aphid management under changing environmental conditions.

Keywords: *Adult survival, Egg hatchability, Low-temperature storage, Mass rearing, Myzus persicae, Pupal emergence.*

Identification of Stable Reference Gene Strategies Using Integrated Algorithmic Approaches for Robust qPCR Normalisation in Pink Bollworm

Joy Das*, Rakesh Kumar, Vivek Shah, Vinita Gotmare and V. N. Waghmare
ICAR-Central Institute for Cotton Research, Nagpur, INDIA
****Corresponding author email: jd.in@aol.com***

Abstract

Accurate normalisation is essential for reliable interpretation of quantitative gene expression data, particularly in organisms exposed to diverse developmental and environmental conditions. However, selecting appropriate internal controls remains challenging because gene expression stability can vary across experimental contexts. In this study, we present a comprehensive evaluation to identify robust normalisation strategies for gene expression analysis in pink bollworm (Lepidoptera: Gelechiidae), an important pest of cotton. We assessed multiple candidate internal controls across a wide range of biological and stress-related conditions, including developmental progression, tissue specificity, temperature variation, chemical treatments, and molecular stressors. Expression stability was rigorously evaluated using a combination of widely adopted statistical algorithms, including ÄCt comparison, Best Keeper, Norm Finder and geNorm, each providing distinct measures of variability and consistency. To improve robustness, results from all methods were integrated using a comprehensive ranking platform that consolidates outputs into a unified stability score. In addition, we applied a dedicated optimisation algorithm designed to identify the most effective single genes and gene combinations for each experimental condition. This approach enabled condition-specific selection of normalisation strategies rather than relying on a universal reference. The combined use of multiple analytical tools revealed that optimal reference gene sets are context-dependent and benefit significantly from algorithm-guided selection. Overall, this study demonstrates the importance of integrating multiple computational approaches for reference gene validation and provides a reproducible workflow to improve accuracy in quantitative gene expression studies under complex experimental conditions.

Keywords: *Pink bollworm, qRT-PCR normalisation, reference genes, expression stability, RefFinder, GrayNorm*

Evaluating Social-Ecological Resilience and its Impact on Agricultural Productivity in West Bengal, India

Kabita Mondal[1*], Sankar Kumar Acharya[2], Apurba Pal[3], Swapnamay Ghosh[4], Sagnik Baul[4] and Avirup Das[4]

[1*]Department of Agricultural Extension, College of Agriculture, Uttar Banga Krishi Vishwavidyalaya, Majhian, Dakshin Dinajpur 733133, West Bengal, India

[2]Former Professor, Department of Agricultural Extension, Bidhan Chandra Krishi Vishwavidyalaya, Mohanpur, Nadia, 741252, West Bengal, India

[3]Department of Plant Physiology, Bihar Agriculture College, Bihar Agricultural University Sabour, Bhagalpur, 813210, Bihar, India

[4]Department of Agricultural Extension, Uttar Banga Krishi Vishwavidyalaya, Pundibari, Coochbehar 736165, West Bengal, India

Corresponding author e-mail: mondal.kabita45@gmail.com

Abstract

Social-ecological resilience-the capacity of farming households and agro-ecosystems to absorb climatic and socio-economic shocks while maintaining essential functions-is increasingly recognized as a critical determinant of agricultural productivity. This study evaluates social-ecological resilience and its relationship with agricultural productivity across three agro-climatic zones of West Bengal, India: the Terai Zone (Jalpaiguri), the Old Alluvial Zone (Murshidabad and Dakshin Dinajpur), and the New Alluvial Zone (Burdwan). Five districts were purposively selected on the basis of the Climate Vulnerability Index published in the All-India Climate Vulnerability Assessment report, representing both highly vulnerable (Malda: VI = 0.690; Jalpaiguri: VI = 0.627) and moderately vulnerable categories. Primary data were collected from 250 farm households using a structured interview schedule. An uncertainty index of crop yield was operationalised as the principal dependent variable, and 32 socio-economic and ecological variables were examined as independent predictors. Correlation analysis, multiple regression, stepwise regression and path analysis were employed to identify the critical drivers. Results indicate that farm size (â = "0.545), land under mixed cropping (â = 0.312), production of organic manure (â = "0.199), size of homestead land (â = 0.223), and perceived changes in late-monsoon onset (â = "0.181) are the dominant determinants of yield uncertainty in West Bengal. The full model explained 68.90% of the variance in yield uncertainty. Path analysis confirmed that farm size exerts a pronounced direct effect ("0.462) while also mediating indirect effects through 12 other exogenous variables. These findings underscore the urgency of promoting mixed cropping, organic manure management, conservation agriculture and market-linked extension services to restore agro-ecological resilience among smallholder farmers in the region.

Keywords: *Agro-climatic zones; Crop yield; Resilience; Vulnerability; Uncertainty*

Effect of harvesting methods on postharvest quality in different mid-season variety of mango

Krishna Dahal

Agriculture and Forestry University, Nepal

Email: dahalitahari@gmail.com

Abstract

The quality of mango as influenced by harvesting method on different mid-season variety was performed in farmer field at KanchanRupa municipality, Saptari and laboratory work at National citrus Research program, Dhankuta from 14th June, 2024 to 30th June, 2024. The research was laid out in two factorial completely randomized design with three replications. The first factor consists of harvesting method (Stick, Pole harvesting net and Fruit picker). The second factor consists of three mid-season mango variety (Chini aamph, Dashehari and Maldah). The Physiochemical quality, Physiological loss in weight (PLW) and Organoleptic test were studied. The highest total soluble solids with respect to harvesting method was obtained in Stick (18.14 °B) and lowest in Fruit picker (16.72 °B) at 10 days after harvesting. The total soluble solids was highest in variety Chini aamph (19.83 °B) and lowest by Dashehari (15.95 °B). The titratable acidity of fruit was highest in Pole harvesting net (0.71) and lowest in fruit picker (0.48) at 10 days after harvesting. No significant difference in titratable acidity of variety was found at 10 days after harvesting. The Physiological loss in weight was least in variety Dashehari (1.26 %) and highest in Chini aamph (2.48 %) at 10 days after harvesting. The organoleptic test score for purchase was superior in both Dashehari (2.87) and Maldah (2.78) variety. The Pole harvesting net (3.20) and Fruit picker (3.00) showed better score in purchase at Organoleptic test. However, there is limitation in use and operational cost for fruit picker.

***Key words**: Mango, physiochemical, test*

Decolorization of Synthetic Dyes by a Purified Latex Peroxidase from *Ficus heterophylla* L.f.

Linika Tayenjam[1], Dr. S. Jibankumar Singh[2*]

Department of Biochemistry, Manipur University, Canchipur, Imphal-795003

To whom correspondence should be addressed:

sjibankr@gmail.com

Abstract

Synthetic dyes released from textile and related industries constitute a significant source of environmental pollution due to their complex chemical structures, high stability, and resistance to conventional wastewater treatment processes (Altahir et al., 2020). Traditional physicochemical and biological treatment methods often suffer from limitations such as high operational costs, incomplete dye removal, and the generation of secondary pollutants. In recent years, plant peroxidases have emerged as promising eco-friendly biocatalysts for the remediation of dye-contaminated effluents (Liu et al., 2024). Latex-derived peroxidases are particularly attractive because of their extracellular localization, ease of extraction, and catalytic versatility. The present study evaluates the dye-decolorizing potential of a peroxidase isolated from the latex of Ficus heterophylla L.f. The enzyme was purified through ammonium sulfate fractionation followed by sequential cation- and anion-exchange chromatography on CM-Sepharose and DEAE-Sepharose, respectively. The purified peroxidase was assessed for its ability to decolorize five structurally distinct synthetic dyes in the presence of hydrogen peroxide. Using 4 U of enzyme and 4 mM H, O, , the peroxidase achieved decolorization efficiencies of 62% for Methyl Orange, 29% for Phenol Red, 22% for Coomassie Brilliant Blue, 14% for Malachite Green, and 7% for Basic Fuchsin under the standard assay conditions. Among the dyes tested, the enzyme exhibited the highest activity toward the azo dye Methyl Orange. These findings demonstrate the potential of Ficus heterophylla latex peroxidase as a green and sustainable biocatalyst for the treatment of dye-containing

industrial effluents. Further optimization and scale-up studies may facilitate its application in environmentally friendly wastewater remediation technologies.

Keywords: *Peroxidase, Latex, Ficus heterophylla L.f., Dye decolorization*

An approach towards food processing waste to animal feed using solid state fermentation

[1]A Chandralekha*; [1]Ronie Thangjam; [2]Chongtham Sonia; [2]N. Umakanta Singh; [2]M. Norjit Singh; [2]Chongtham Tania;

[1]Naturitech Private Limited, Imphal Manipur

[2] ICAR Research Complex for NEH Region, Lamphelpat, Imphal

Emal: puniayekpam@gmail.com

Abstract

With an increase in population, there is an increase in rate and demand of cattle feed due to limited availability of raw material. On the other side there are a huge loss in industrial food processing waste due to non-proper utilization. In our present study, pineapple waste will be used for value addition as it generates about 50-60% of waste. Solid state fermentation technology was used for nutrient enrichment using yeast. Standardization of process parameters such as fermentation time and concentration of culture was carried out. Among different fermentation time, 3 days of incubation at 27±2p C resulted in the highest protein content. Results show significant increase in protein and reduction of fiber. In order to check the feasibility to convert the fermented substrate into product form, an attempt was made using different carriers such as maize powder, rice bran and gum acacia. Proximate analysis of the products was also carried out, where an interesting result are obtained. With the results it can be said that fermented pineapple waste could be a good source for animal feed production.

Keywords: *Pineapple waste, solid state fermentation, encapsulation, carrier materials, animal feed*

Screening Of Rice Landraces for Phosphorus Deficiency Tolerance Using Principal Component, Cluster, And Rescaled Index Analyses

Manas Ranjan Hota[1], *Maheswar Dey[1], Visnhupriya S.[1], Lakshmi Hijam[1], Shubhrajyoti Sen[1], Suvendu Kumar Roy[1], Bidhan Roy[2]

[1]Department of Genetics and Plant Breeding, [2]Department of Seed Science and Technology, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar – 736165

****Email: 2000deymaheswar@gmail.com***

Abstract

Phosphorus (P) deficiency is a major constraint to rice production, particularly in low-input production systems. To identify phosphorus deficiency-tolerant rice landraces, forty rice genotypes along with four local checks were evaluated under phosphorus-sufficient (Pz) and phosphorus-deficient (P{) field conditions during Kharif 2022 at the Agricultural Instructional Farm of Uttar Banga Krishi Vishwavidyalaya, Cooch Behar, West Bengal, using an augmented design. Fifteen agro-morphological, yield, and nutrient-related traits were recorded. Principal Component Analysis (PCA) revealed substantial genetic variability among the genotypes under both phosphorus environments. The first five principal components under Pz and the first six principal components under P{ accounted for the majority of total variation. Under phosphorus-deficient conditions, phosphorus uptake, harvest index, spikelet

fertility, and filled grains per panicle emerged as major contributors to genetic divergence, highlighting their importance in adaptation to low-phosphorus stress. Cluster analysis grouped the 44 genotypes into seven clusters under Pz and five clusters under P{ conditions, indicating considerable genetic diversity and differential adaptive responses among the landraces. Rescaled Index (RI) analysis enabled simultaneous assessment of multiple traits and identified superior genotypes under contrasting phosphorus regimes. Under Pz condition, Sadamala, Birohi, Banga Bandhu, Dehradun Gandeshwari, and Chakhao Angangba were the highest-ranked genotypes, whereas under P{ condition, Birohi, Dehradun Gandeshwari, Chapka Chakhao, Ranga Kamal, and Banga Bandhu exhibited superior overall performance. The integration of PCA, cluster analysis, and RI ranking identified that Chapka Chakhao is particularly noteworthy because it combined favourable PCA contribution, distinct cluster placement, and a high RI ranking under phosphorus deficiency, making it a strong candidate for breeding programmes aimed at improving phosphorus-use efficiency in rice. Conversely, Radhunipagal, Chakao Samparn, and Dudheshwar-3 consistently ranked among the poorest performers and may serve as susceptible checks in future phosphorus-deficiency screening studies.

Keywords: *Rice, Phosphorus deficiency, PCA, Cluster analysis, Rescaled index.*

Evaluation of Aluminium Toxicity Tolerance in Wheat (*Triticum aestivum* L.) Genotypes under Hydroponic Culture

Meghna Purkait*[1], Shubhrajyoti Sen[1], Saikat Das[1]

[1]Department of Genetics and Plant Breeding, Uttar Banga Krishi Viswavidhyalaya, Pundibari, Coochbehar, 736165, West Bengal, India

Corresponding author e-mail: meghnapurkait46@gmail.com

Abstract

Acid soils with a pH of 5.5 or lower are one of the most important limitations to agricultural production worldwide. Approximately 30% of the world's total land area consists of acid soils, and as much as 50% of the world's potentially arable lands are acidic. The production of staple food crops, and in particular food grains, is negatively impacted by acid soils. A large part of eastern and North- Eastern India faces lower productivity of agriculture crops due to acidic soil condition. Aluminium (Al) toxicities are one of the major growth limiting factors that have been associated with the acid soil complex. Al toxicity is particularly severe at soil pH values of 5.0 and below, but can occur as high as pH 5.5 in kaolinitic soils (Foy, 1984; Kamprath et al., 1985). Genotypes within same species differ widely in tolerance to Al and some of these differences are genetically controlled. It is reported that in certain regions of China, wheat grains can accumulate higher Al content compared to other cereals such as rice, maize, soybean, and millet (Liang et al., 2019). This suggests a potential risk for food safety and highlights the importance of managing Al uptake in wheat. The present study was conducted with some recently released varieties of wheat, which were grown under different aluminium concentration in hydroponic culture with a view to evaluate the differential response of wheat genotypes to Aluminium stress. Total 08 treatments of $AlCl_3$ (100mM, 200mM, 300mM, 400mM, 500mM, 600mM, 700mM, 800mM) were used for this study with control. Parameters such as root length, shoot length and root tolerance index (RTI) were measured for Al toxicity tolerance. Two histochemical stainings viz. *Hematoxylin* staining (to determine the accumulation of aluminium) and *Evans Blue* staining (to determine the root damage due to aluminium toxicity) were also used. The result showed that, HD3369

recorded the highest RTI value whereas the lowest one was variety HI1633. In case of *hematoxylin* staining, variety PBW915 exhibited the highest absorbance value followed by HI1633. However, in case of *Evans Blue* staining, variety HI1633 was having the highest absorbance followed by HD3411. In most of the varieties the absorbance of *hematoxylin* stain was found gradually increased from 100mM to 300mM concentration of $AlCl_3$. However, *Evans Blue* staining showed highest fold increase occurred between 500mM to 800mM concentration.

Keywords: *Acid soil, Aluminium toxicity, Root tolerance index, wheat*

Performance of IBA Concentrations for Rooting of Dragon Fruit Stem Cuttings

Mukul Kumar[1] Akhilesh Kr. Singh[2] & Love Kumar[3]
Department of Plant Physiology, HRC, Kishanganj,(BAU,Bihar)
Department of Soil Science, HRC, Kishanganj, (BAU,Bihar)
Department of Agriculture Engineering, DKAC, Kishanganj ,(BAU,Bihar)
****Corresponding Author- kumar.mukul93@gmail.com***

Abstract

A field experiment was conducted at the experimental farm of Horticulture Research centre, Kishanganj, Bihar during with an objective to study the influence of exogenous IBA on rooting behaviour of dragon fruit cuttings. The treatment consists of different concentrations of IBA viz: IBA @ 100 ppm, IBA @ 200 ppm, IBA @ 500 ppm, IBA @ 1000 ppm, IBA @ 2000 ppm, IBA @ 4000 ppm, IBA @ 8000 ppm) and a control No IBA treatment). Planting material were selected from mother orchard; cuttings should be fresh and healthy appearing with approximately 30 cm long. The influence of exogenous application of IBA concentrations was observed with parameters like days required for root initiation, number of roots, length of root, root fresh weight. The results clearly endorsed a positive performance of IBA @ 8000 ppm towards rooting behaviour in dragon fruit cuttings. Treatment with IBA @ 8000 ppm exhibited significant earliness in root initiation (23 days) over treated with lower concentrations, as well as untreated cuttings (30 days). Along with early rooting, same treatment also found responsible for emergence of maximum number of roots (39.00) and higher fresh root weight (26.12 g). Cuttings treated with IBA @ 8000 ppm, produced roots with longest length (31.25 cm) however untreated cuttings reported shortened and weakened root system at 100 days after planting. Hence, from present investigation, it was found that the IBA @ 8000 ppm could be used for better rooting and establishment of dragon fruit cuttings.

Keywords: *concentrations, treatment, fresh weight, rooting, investigation*

Psychosocial Well-Being of Farmers in Manipur: A Review of Challenges, Protective Factors, and Intervention Strategies

Narmada Hidangmayum
Central Agricultural University, Imphal, Manipur
Email id: hnarmada@gmail.com

Abstract

Agriculture remains the primary livelihood source for a large proportion of the population in Manipur, where farming is characterized by small and fragmented landholdings, dependence on monsoon rainfall, limited mechanization, and vulnerability to environmental and socio-economic uncertainties. These

conditions significantly influence the psychosocial well-being of farmers. The present review synthesizes existing literature on the psychosocial well-being of farmers with special reference to Manipur and the broader North Eastern region of India. The review examines the major determinants affecting farmers' mental health, including financial insecurity, indebtedness, climate variability, crop failure, market fluctuations, inadequate access to credit and insurance, poor extension services, and limited healthcare facilities. These stressors often contribute to heightened levels of stress, anxiety, depression, emotional distress, and reduced quality of life among farming communities. The review further highlights the role of protective factors such as family support, community cohesion, cultural values, social participation, spiritual beliefs, institutional support, and resilience-building practices that help farmers cope with adversities. Traditional social structures and collective community networks prevalent in Manipur serve as important buffers against psychological distress. However, rapid socio-economic changes, climate-related risks, and increasing uncertainty in agricultural livelihoods pose emerging threats to farmers' psychosocial well-being. The findings highlight the need for integrated interventions that combine agricultural development with mental health promotion. Strengthening extension services, improving access to financial and insurance support, promoting climate-resilient agriculture, enhancing mental health awareness, and developing community-based support systems are essential for improving farmers' well-being. The review concludes that addressing psychosocial well-being is critical for ensuring sustainable agricultural development, livelihood security, and overall rural prosperity in Manipur.

Keywords: *Psychosocial well-being, Farmers, Mental health, Stress, Resilience, Rural livelihoods.*

Selection and characterization of halotolerant bacteria and their evaluation for management of salt stress

Neerja Rana*, Rinkal Dhiman and Titiksha Thapa

Department of Basic Sciences, Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan, H.P

Corresponding author e-mail: drneerjauhf24@yahoo.co.in

Abstract

Salt stress is one of the most vulnerable abiotic problems in agriculture which affects soil properties and plant growth. The use of halotolerant (salt tolerant) plant growth promoting rhizobacteria (PGPR) is an ecofriendly approach for enhancing plant growth under saline conditions. A study was conducted to isolate and identify halotolerant PGPR and to study their response to salinity tolerance and improvement in growth and yield of okra. The halotolerant bacterial isolates were isolated from salt mines of Himachal Pradesh and from the salt affected fields of Gujarat, Rajasthan, Haryana and Punjab. The isolates were screened for salt tolerance ability and secondary halotolerant activities like ACC deaminase enzyme activity and Exopolysaccharides (EPS) production. These isolates were further screened for multifarious plant growth promoting traits viz., phosphate solubilization, nitrogen fixation, ammonia production, HCN production and siderophore production. The interactive effect of salinity stress and selected PGPR was also observed for the germination parameters of okra seeds. The most efficient halotolerant and growth promoting bacterial isolates were selected to study the growth and yield of okra under net house conditions. A total of 103 bacterial isolates were screened out of which 42 isolates were able to tolerate higher (10%) concentration of Sodium Chloride (NaCl). The isolate RBP-4 recorded highest Exopolysaccharides (2.94 mg/ml) and ACC deaminase production (0.74 ìg/ml) followed by HPB-3

with 2.76 mg/ml and 0.65 ìg/ml Exopolysaccharides and ACC deaminase production respectively. The isolate HPB-3 demonstrated maximum Phosphate solubilization (88.27ìg/ml), siderophore production (85.21ìg/ml) and IAA production (85.25 ìg/ml) followed by isolate RBP-4 with 85.61ìg/ml, 85.21ìg/ml, 80.04 ìg/ml of phosphate solubilization, siderophore production and IAA production respectively. Both isolates significantly increased the seed germination parameters namely radicle length, seedling fresh weight, per cent germination, vigour index and salt tolerance index under salt stress of 0, 25, 50, 75 and 100 mM NaCl. These bacterial isolates were identified as *Sphingobacterium detergens* (HPB-3) and *Sphingobacterium multivorum* (RBP-4) based on 16S rDNA sequencing. The individual and consortium application of *Sphingobacterium detergens* and *Sphingobacterium multivorum* significantly increased the plant growth parameters under 2-10% NaCl. Therefore, the consortia of the two halotolerant isolates can be used for the management of salt affected soils.

Keywords: *Salt stress, Halotolerant PGPRs, Plant growth promotion, Okra*

Promoting Nutri-Cereals through Mass Media: Evidence from Bihar

Niraj jha*
Research Scholar, Department of Journalism and Mass Communication,
School of Journalism and Mass Communication, Lnct University Bhopal.(M.P.)
Contact number-8620964443,
Email ID: jha5976@gmail.com.
Supervisor:
Dr. Akansha Maheshwari
Assistant Professor of Lnct University Bhopal
Email ID : Akanshamaheshwari.06@ gmail.com

Abstract

The traditional nutrient-rich crops known as nutri-cereals, or millets, are important for climate resilience, sustainable agriculture, and nutritional security. These crops are crucial for combating malnutrition and encouraging healthy eating habits since they are high in fiber, protein, iron, calcium, and other vital minerals. Because millets can tolerate harsh weather conditions and use less water, they are also environmentally sustainable. Despite these benefits, millets' cultivation and consumption have decreased in Bihar because to shifting dietary choices, a lack of market support, and low public knowledge .The mass media is crucial to the spread of knowledge, the creation of consciousness, and the modification of social norms. Information about agriculture and health may now be effectively disseminated to farmers and consumers through print, radio, television, social media, and digital communication platforms. It is possible to successfully raise awareness of the nutritional, financial, and environmental advantages of millets using media campaigns and communication tactics. The current study looks at how the media in Bihar promotes nutri-cereals. The study focuses on how various media outlets raise awareness and have an impact on farmers and consumers about millet production, consumption, government programs, and sustainable farming methods. Additionally, it assesses how well agricultural communication tactics and media campaigns promote millet uptake and enhance public opinion of nutri-cereals. Both primary and secondary data serve as the foundation for the study. Surveys, interviews, and questionnaires involving farmers, consumers, media professionals, and agricultural specialists from certain Bihar districts will be used to gather primary data. Government publications, academic journals,

newspapers, books, and internet resources will all be used to gather secondary data. Statistical and descriptive techniques will be used to analyze the gathered data .It is anticipated that the study would emphasize how important mass media is as a potent communication tool for advancing millets and sustainable agriculture in Bihar. Policymakers, media outlets, and agricultural groups may find the data useful in creating communication plans for rural development, environmental sustainability, and nutritional security.

Keywords: *Nutri-Cereals, Millets, Mass Media, Bihar, Nutritional Security, Sustainable Agriculture, Agricultural Communication*

Weather-Driven Forecasting of Potato Late Blight in West Bengal, India: An Integrated Statistical and Machine Learning Framework

Debraj Mitra, Pradip Basak* and Deb Sankar Gupta
Department of Agricultural Statistics, Uttar Banga Krishi Viswavidyalaya, Cooch Behar, West Bengal
Email: pradip@ubkv.ac.in

Abstract

Potato late blight (PLB), caused by *Phytophthora infestans*, is one of the most destructive diseases affecting potato production in West Bengal, India. This study investigated the effects of key weather variables on PLB severity under early, normal, late, and pooled planting conditions, and developed predictive models for disease severity [percent disease index (PDI)] and disease initiation [days after planting to first appearance (DAPFA)]. Correlation and Random Forest analyses identified minimum temperature as the most influential factor governing disease development across all planting conditions, followed by maximum temperature and sunshine hours. Five forecasting approaches, ARIMA, ARIMAX, Support Vector Regression (SVR), Random Forest (RF), and Time-Delay Neural Network with exogenous variables (TDNNx), were evaluated for PDI prediction. SVR performed best under early planting, whereas TDNNx consistently outperformed other models under normal, late, and pooled conditions. Forecasts for the 2024–25 season projected rapid disease progression under late planting, with severity reaching nearly 100% within 28 days after first appearance, emphasizing the need for timely intervention before 21 days. For DAPFA prediction, the GM(1,1) grey model showed the highest accuracy under early planting. The findings highlight the dominant role of temperature in PLB epidemiology and demonstrate the utility of integrating statistical and machine-learning techniques for robust, planting-condition-specific disease forecasting. These models can support timely disease management decisions and improve the resilience of potato production systems.

Keywords: *Potato late blight, disease forecasting, ARIMA, SVR, TDNNx, Grey Model.*

Ecological health and trophic functioning of the Rushikulya Estuary: insights from multitrophic community analysis and Ecopath modelling

Pranab Gogoi[1]*, S. K. Das[1], P. Panikkar[1], B. K. Das[1], T. N. Chanu[1], S. Bidyasagar[2], S. K. Manna[1]
[1]ICAR-Central Inland Fisheries Research Institute, Barrackpore, Kolkata- 700120
[2]College of Fisheries, Dr. R. P. Central Agricultural University, Dholi – 843121, Bihar

Corresponding author e-mail: pranabgogoi@gmail.com

Abstract

An assessment was carried out to understand the spatio-temporal dynamics of ecosystem attributes, trophic dynamics in the Rushikulya estuary (RE). The mean values of TRIX (5.04±0.72) and TRBIX (0.17± 0.08) reflected that the RE has a moderate degree of eutrophication with *'good'* water quality and *'biomass saturated'*. In total, 101 fish species (75 genera, 44 families, 22 orders) were recorded. Fish species richness was higher during the pre-monsoon (85 species; 63 genera) followed by monsoon (71; 56) and post-monsoon (53; 43). 15 fish species were dominant (ã=>0.01) mainly from Mugilidae, Leiognathidae, Dorsomatidae and Carangidae. Of the five functional fish ecological guilds, the dominance of 'marine migrants' (62–67%) and 'marine stragglers' (9–21%) over 'estuarine use' species indicates a strong influence of the salinity regime on the fish community. Of the 14 algal groups recorded (133 taxa; 95 genera), Mediophyceae was the chief contributor (12–36%) followed by Bacillariophyceae (7–22%). 69 taxa of zooplankton (59 taxa–copepod) were recorded, with Cyclopoida (17 taxa) remaining as the top contributor (19.33%). The benthic index (BENTIX: 2.80–3.72 and AMBI: 0.33–2.38) depicted that the estuary state was 'moderate' to 'good', and its ecological health was relatively stable. The ECOPATH model of the RE defines that the trophic flows in 23 functional groups, confined with TLIII (avg. TL 2.886). Silver billies, ambassids and clupeids were the most exploited fish groups based on EE including invertebrates' benthos (0.972) and crabs (0.970). Croakers and Eels & Rays were the keystone species. Based on the mixed trophic index, lower trophic level functional groups had a positive impact on the higher trophic levels, a '*bottom-up control*' ecosystem. Total System Throughput was 10888.710 t $km^2 year^{-1}$. Ecosystem regulators (TPP/TB, TPP/TR and TB/TST) and ecosystem maturity indices of RE stated a '*moderately mature'* ecosystem.

Keywords: *Biotic community, trophic structure, estuary health*

Opportunities of Entrepreneurship in Horticulture and Allied Fields: Innovations for Sustainable Rural Development and Economic Growth

Priya Priyanka Tudu[1]

Department of Horticulture Vegetable Science,GD Goenka Education City, Gurugram - Sohna Road, Delhi NCR, Haryana - 122103, India

Corresponding author email: ptudu84@gmail.com

Abstract

Entrepreneurship in horticulture and allied sectors has emerged as a powerful driver of agricultural transformation, employment generation, and rural economic development. With increasing consumer demand for high-value fruits, vegetables, flowers, medicinal plants, mushrooms, organic produce, and value-added products, the horticulture sector offers immense opportunities for innovative agribusiness ventures. This paper examines the entrepreneurial potential in horticulture and related fields by highlighting emerging areas, including precision farming, protected cultivation, hydroponics, vertical farming, post-harvest management, food processing, agritourism, digital agriculture, and smart supply chain solutions. The study emphasizes the role of technology-driven enterprises in enhancing productivity, reducing post-harvest losses, improving market access, and increasing farmers' income. Innovative business models integrating artificial intelligence (AI), Internet of Things (IoT), blockchain-based traceability, mobile advisory services, and e-commerce platforms are identified as key enablers for

sustainable growth. Special attention is given to startup opportunities for youth, women entrepreneurs, and rural communities through nursery management, organic input production, floriculture enterprises, mushroom cultivation, beekeeping, and horticultural value addition. The findings suggest that entrepreneurial initiatives in horticulture can significantly contribute to food security, environmental sustainability, and economic resilience while creating diversified income sources. Strengthening access to finance, skill development, incubation support, market intelligence, and policy incentives can further accelerate entrepreneurial success in this sector. The study concludes that innovation-led horticultural entrepreneurship represents a promising pathway for building a competitive, sustainable, and technology-oriented agricultural economy in the twenty-first century.

Keywords: *Horticulture Entrepreneurship, Agribusiness Innovation, Precision Agriculture, Value Addition, Sustainable Agriculture, Rural Development, Agri-Startups, Digital Farming, Allied Agriculture, Economic Growth.*

Glowing guardians of the rhizosphere: the promise of fluorescent pseudomonads for sustainable crop health management in Eastern Gangetic plains of West Bengal

Raina Saha[*1], Anamika Debnath[2], A. Roy[3], P.M. Bhattacharya[4], A.K. Chowdhury[5]
[1,2,3,4,5]Department of Plant Pathology, Faculty of Agriculture, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar- 736165
[*]***Presenting/Corresponding Author E-mail: merainasaha2015@gmail.com***

Abstract

Fluorescent pseudomonads group of PGPR serves a major role in inhibition of plant pathogenic fungi and bacteria and also enhance the plant growth. These bacteria are known to produce certain metabolites which play a significant role in rhizosphere. Under this research, 22 bacterial isolates from different plant rhizosphere were purified after isolation and identified based on different biochemical reaction like Catalase, Oxidase activity, Citrate utilization, Antibiotic profiling test etc. The major antimicrobial properties viz. Rhizosphere colonization, Volatile and non-volatile compounds, siderophore production and PGPR properties like Ammonia production assay, Phosphorus, Potassium and Zinc solubilisation test was done under *in-vitro* condition and Based on *in-vitro* studies three best performing isolates were selected for *in-vivo* experiment in Lentil (Variety- WBL77) and Tomato (Variety- Rocky) field. In field trial among three isolates (PF5, PF7 & PF17) PF17 gave most promising result. PF17 isolate was identified through 16S rRNA based molecular method and sample showed 99.81% similarity with *Pseudomonas protegens (GenBank Accession no.* PPO25826.1) based on nucleotide homology and phylogenetic analysis. Irrespective of crop plants UBPF 17 performed well in enhancement of Root length, early flowering and yield and also in reduction of disease severity and disease incidence. In IDM, *Pseudomonas protegens* in combination with chemical fungicide resulted in 26-38% reduction in leaf blight incidence and 28-32% increment in yield. The use of PGPR in combination with chemical fungicides has been suggested to manage the leaf blight of Lentil in a sustainable manner. So, PGPR is a valuable component of IDM and farmers can market their produce as organic products to earn better monetary value.

Keywords: *PGPR, Fluorescent pseudomonads, Antimicrobial, Molecular identification, In Vivo, IDM*

Green synthesis of Zinc and Iron Nanoparticles and their effect on seed germination, seedling growth, antioxidant activity and biochemical properties in black cumin

Rehum Rai[1], Dipak Kumar Murmu[2], Bimal Das[3]

[1]Department of Plantation Crops and Processing, Uttar Banga Krishi Viswavidyalaya, Pundibari, 736165, Coochbehar, West Bengal, India

[2]Regional Research Station (OAZ), Uttar Banga Krishi Viswavidyalaya, Majhian, 733133, Dakshin Dinajpur, West Bengal, India

[3]College of Agriculture (Extended campus), Uttar Banga Krishi Viswavidyalaya, Majhian, 733133, Dakshin Dinajpur, West Bengal, India

Abstract

Moisture stress hampers the physiological process resulting reduced plant growth, antioxidant activity and increases antinutritional compound. Current study evaluated the effect of biosynthesized Zinc oxide nanoparticles (ZnO NPs) using *Swietenia macrophylla* seed extracts and Iron nanoparticles using *Ficus carica* fruits on seed germination, seedling growth, antioxidant activity and biochemical activities on black cumin under moisture stress. The black cumin variety 'AN-20' was treated with four different concentrations of Nano-scale ZnO (100, 200, 300 ppm) and Fe_3O_4 (200, 300 400 ppm) including control. Different characterization techniques (UV, SEM and FTIR) were employed for confirmation of size, shape, and surface structure of NPs. The study measured the growth of the plants, and antioxidant activities in 21-day-old plants and biochemical activities in 60 DAP plants in main field. Based on biomass assay, it was found that the nanoparticle-treated seedlings displayed better growth than the control, demonstrating a positive effect of the treatment. The results indicated that ZnO and Fe_3O_4-NPs applications improved seedling parameters of black cumin plants, and enhanced antioxidant and biochemical content in a manner proportional to the concentration. Moreover, in current research, it has been found that ZnO and Fe NPs applications improved antioxidant response, and production of antioxidant enzymes under moisture stress condition. There was a significant change in ferric-reducing antioxidant power (FRAP), 2-diphenyl-1-picrylhydrazyl (DPPH), and antioxidant reducing power (RP) activity of black cumin exposed and Assay of Electrolyte Leakage, Determination of K+ and Na+, Protein, Chlorophyll, b carotene, Starch content to ZnO and Fe NPs. Therefore, biogenic ZnO NPs and Fe may have better growth performance, increased antioxidant capacity, biochemical properties and the potential to reduce chemical hazards when applied at appropriate doses.

Keywords*: Nigella sativa, seed germination, antioxidant activity, nanoparticles, ZnO, Fe_30_4.*

Impact of Folic Acid supplementation on Birth Outcomes

Renu[1], Dr. Poonam Yadav[2]

[1]Ph.D. student, Department of Human Development and Family Studies, I.C College of Community Sciences, Chaudhary Charan Singh Haryana Agricultural University, Hisar 125004, Haryana

Email: brarrenu08@gmail.com

[2]DES (H.Sc) KVK Mgarh, Department of Human Development and Family Studies, I.C College of Community Sciences, Chaudhary Charan Singh Haryana Agricultural University, Hisar 125004, Haryana

Abstract

One essential element needed for healthy fetal growth and development during pregnancy is folic acid, a synthetic version of vitamin B9. It is well known that consuming enough folic acid prior to conception and during pregnancy is a successful public health strategy for lowering unfavorable outcomes for mothers and newborns. In addition to analyzing the variables that affect pregnant women's use of folic acid supplementation, this paper attempts to summarize the body of research on the connection between folic acid supplementation during pregnancy and birth outcomes. The results consistently show that folic acid supplementation improves fetal growth and development and dramatically lowers the chance of neural tube abnormalities (NTDs), such as spina bifida and anencephaly. Additionally, research indicates that consuming enough folic acid is linked to a decreased risk of congenital defects, low birth weight, preterm birth, and pregnancy-related problems. Folic acid is essential during the periconceptional and early stages of pregnancy due to its biological involvement in DNA synthesis, cellular proliferation, and neural development. The review also identifies a number of factors that influence folic acid consumption, such as mother education, socioeconomic position, awareness levels, availability of prenatal care facilities, and compliance with supplementation recommendations. Inadequate understanding and delayed supplementing initiation continue to be major obstacles despite international recommendations, especially in low- and middle-income countries. In summary, there is substantial evidence that folic acid supplementation is a safe, economical, and evidence-based approach to enhancing birth outcomes and lowering avoidable birth abnormalities. To improve compliance and encourage healthier pregnancy and neonatal outcomes, nutrition education, preconception counseling, and public health activities must be strengthened.

Keywords: *Folic Acid, Pregnancy, Birth Outcomes, Neural Tube Defects, Maternal Nutrition, Prenatal Care.*

Yacon (*Smallanthus sonchifolius*): an underexploited crop of the Himalayan region of West Bengal with multiple nutritional benefits

Rohini Pradhan*,[1] Suchand Datta and R. K. Sarkar
Department of Vegetable and Spice Crops,
Uttar Banga Krishi Viswavidhyalaya
Pundibari, Coochbehar, West Bengal – 736165.
Email address of the communicated author: rohinipradhan19@gmail.com

Abstract

Yacon (*Smallanthus sonchifolius*), an Andean root crop, has gained increasing attention as a functional food due to its unique nutritional composition and health-promoting properties. The tuber is characterized by a high content of fructooligosaccharides (FOS) and inulin-type fructans, non-digestible carbohydrates that exert prebiotic effects by selectively stimulating beneficial gut microbiota. Recent studies have demonstrated that regular consumption of yacon can improve intestinal health, enhance short-chain fatty acid production, and contribute to better glycemic regulation and lipid metabolism Research has also highlighted the presence of bioactive compounds associated with antidiabetic, anti-obesity, and cardioprotective effects. The low caloric value and low glycemic impact of yacon make it a promising dietary component for individuals with metabolic disorders such as obesity and type 2 diabetes. Furthermore, recent investigations into processing methods have shown that appropriate drying and

preservation techniques can maintain high levels of fructans and antioxidant compounds, enhancing the nutritional quality of yacon-derived products. Emerging evidence suggests that yacon flour, syrup and other functional food formulations may serve as valuable ingredients in health-oriented diets. Overall, yacon represents a nutritionally rich crop with substantial potential for promoting gut health, metabolic balance, and antioxidant defense, supporting its growing use in functional foods and nutraceutical applications.

Keywords*: yacon, glycemic index, FOS, nutraceutical, tuber*

Horticulture 4.0: An Econometric Assessment and Socio-Technical Framework for India's Next Agricultural Growth Engine

Sagnik Baul[1*], Kabita Mondal[2]

[1]Department of Agricultural Extension, Uttar Banga Krishi Vishwavidyalaya, Pundibari, Coochbehar 736165, West Bengal, India

[2]Department of Agricultural Extension, College of Agriculture, Uttar Banga Krishi Vishwavidyalaya, Majhian, Dakshin Dinajpur 733133, West Bengal, India

****Corresponding author e-mail: sagnikbaul9@gmail.com***

Abstract

This study evaluates the macroeconomic impact of India's horticultural sector and establishes an institutional framework to overcome the grassroots barriers limiting "Horticulture 4.0" technology adoption. Occupying only 13.3% of the cropped area but generating 34.45% of agricultural Gross Value Added (GVA), horticulture permanently outpaced national foodgrain volumes in 2012-13, reaching an anticipated 354.74 MT in 2023-24. Log-linear trend modelling (2014-2024) reveals a highly consistent production trajectory with a constant Compound Annual Growth Rate (CAGR) of 1.182% ($R^2 = 0.98546$, $F = 677.75$, $P < 0.001$). Parallel ordinary least squares (OLS) regression models confirm that while nominal output at current prices explains 93.04% of current agricultural GVA variance ($R^2 = 0.9304$, $\hat{a}_1 = 0.0515536$, $P = 0.007969$), real output at constant prices explains a dominant 98.17% ($R^2 = 0.981735$, $\hat{a}_1 = 0.0348300$, $P = 0.001053$). This econometric divergence proves that horticulture functions as a structurally resilient growth engine driven by real volume expansion rather than temporary market price spikes. However, the grassroots deployment of high-tech advancements including LoRaWAN sensor networks, automated vertical farming, deep learning foliar diagnostics (99.18% accuracy), and blockchain logistics remains heavily constrained by steep initial capital expenditures and severe digital illiteracy among fragmented smallholders. To bridge this gap, this paper introduces a socio-technical mapping matrix and a three-pillar delivery framework that shifts national policy toward communal infrastructure subsidies under MIDH, transitions capacity building to experiential digital Farmer Field Schools, and leverages structural aggregation through Farmer Producer Organizations (FPOs) to successfully scale and de-risk advanced post-harvest value chains.

Keywords: *Macroeconomic impact; Horticulture Growth Engine; OLS Regression; CAGR Trends; Horticulture 4.0; Socio-Technical Matrix.*

Histological Study on Spleen of Dog (*Canis lupus familiaris*)

Sakshi Rathore[1], Ashok Dangi[*], Pankaj Kumar Thanvi[*], Devendra Singh[*], Rajkumar siyag[*]
Department of Veterinary Anatomy, College of Veterinary and Animal Science, Rajasthan University of Veterinary and Animal Sciences Bikaner (Rajasthan)
Corresponding author email: 19597sakshi@gmail.com

Abstract

The Histological studies were conducted on the 10 spleens of dog. Microscopic studies revealed that its capsule and trabeculae emerged from the capsule and entered into parenchyma forming a net like framework. Splenic parenchyma was composed of white and red pulps. White pulp consisted of lymphatic nodule and periarterial lymphatic sheath. The Periarterial lymphatic sheath was abundant. The red pulp was splenic sinusoids and splenic cords. The splenic sinusoids (Venous sinus) were well developed and abundant.

Keywords*: Histology, Spleen, Dog*

Enhancing Sustainable Strawberry Production Through Biological Management of Fusarium Wilt

Sakshi Sharma*[1], Vanshika Sharma[2], and Dr. Deepak Kumar[3]
[1]Ph.D. Scholar, [2]M.Sc. Scholar and [3]Professor, Division of Plant Pathology, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Main Campus, Chatha, Jammu-180009
****Corresponding author: sakshi589sharma@gmail.com***

Abstract

Fusarium wilt caused by *Fusarium oxysporum* f. sp. *fragariae* is a serious threat to strawberry cultivation. This study evaluated eight botanicals *viz;* neem (*Azadirachta indica*), calotropis (*Calotropis gigantea*), tulsi (*Ocimum tenuiflorum*), datura (*Datura stramonium*), mehendi (*Lawsonia inermis*), moringa (*Moringa oleifera*), drek (*Melia azedarach*),s and bhang (*Cannabis sativa*) at 10%, 20%, and 30% concentrations using the poison food technique and four biocontrol agents (BCAs): *Trichoderma harzianum*, *Trichoderma viride*, *Pseudomonas fluorescens*, and *Bacillus subtilis* using the dual culture technique. Radial growth (mm) and percent inhibition over control were recorded after 7 days. Among botanicals, neem at 30% showed the highest inhibition (88.9%), followed by calotropis at 30% (80.0%) and tulsi at 30% (68.9%). Bhang at 10% was the least effective (16.7% inhibition). Among BCAs, fungal agents outperformed bacterial ones. *Trichoderma harzianum* gave maximum inhibition (86.7%), followed by *Trichoderma viride* (77.2%). *Bacillus subtilis* was the least effective (46.1% inhibition). The study concludes that neem (30%) and *Trichoderma harzianum* are highly promising eco-friendly options for managing Fusarium wilt of strawberry in vitro, and may be integrated into sustainable disease management programs.

Keywords: *Fusarium wilt, strawberry, botanicals, neem, Trichoderma harzianum, poison food technique.*

The Personality-Vitamin D-Cognition Nexus: Exploring Their Interconnected Relationship Through a Systematic Review

Sangeeta[1*] and Dr. Poonam Malik[2]

[1]Ph. D. Scholar, Department of Human Development and Family Studies, I. C. College of Community Science, CCS Haryana Agricultural University, Hisar, 125004
[2]Assistant Scientist, Department of Human Development and Family Studies, I. C. College of Community Science, CCS Haryana Agricultural University, Hisar, 125004
Corresponding author e-mail: Lohansangeeta19@gmail.com

Abstract

Individuals' thoughts, emotions, and behaviours are influenced by their personality, which shapes lifestyle decisions that have significant effects on health and well-being. The Five-Factor Model (FFM), which includes neuroticism, agreeableness, extraversion, conscientiousness, and openness, is frequently used to explain personality characteristics. Recent research indicates that food habits and cognitive performance are related to personality factors. Due to its significance for brain health and cognitive functions, vitamin D has received a lot of attention among nutritional considerations. A fat-soluble hormone, vitamin D is necessary for immunological, neurological, and skeletal processes. Sunlight exposure and dietary sources, such as plant-derived ergocalciferol (Vitamin D,) and animal-derived cholecalciferol (Vitamin D*f*), provide it. This review summarizes researches on the connections between personality traits, vitamin D levels, and cognitive abilities. According to relevant research, enough levels may promote executive functioning, memory, and learning. Furthermore, dietary choices, age-related cognitive results, and health behaviours have all been connected to personality traits. According to recent research, vitamin D may be a biological process by which personality affects cognition. The potential contribution of vitamin D to personality expression and cognitive function is further highlighted by existing literature. However, there is still minimal and inconsistent data linking personality traits to vitamin D levels. According to recent research, personality, vitamin D, and cognitive ability are all related. By providing insights into the molecular processes underlying individual differences in cognition, vitamin D may play a significant role in the relationship between personality traits and cognitive health. To determine causal links and elucidate how personality-related behaviours and vitamin D levels simultaneously contribute to cognitive outcomes across the lifetime, more study is required.

Keywords: *Cognition, Personality, Sunshine Vitamin, Dietary choices*

Effect of Transplanting Time and Nutrient Management Practices on Growth Characteristics of Tulaipanji Rice

***Sanjivani Karki[1], Jyotirmay Karforma[2] and Partha Sarathi Patra[3]**

Sub theme: Climate Resilient Agriculture

[1] Research Scholar, Department of Agronomy, Uttar Banga Krishi Viswavidyalaya, Pundibari, Coochbehar,736165, West Bengal, India
[2] Professor, Department of Agronomy, College of Agriculture (Extended Campus) Uttar Banga Krishi Viswavidyalaya, Majhian, Dakshin Dinajpur,733133, West Bengal, India
[3] Assistant Professor, Department of Agronomy, Uttar Banga Krishi Viswavidyalaya, Pundibari, Coochbehar,736165, West Bengal, India
Corresponding author's email: sanjivanikarki1@gmail.com

Abstract

Tulaipanji is a non-Basmati aromatic rice landrace of North Bengal, valued for its unique grain quality and aroma. Appropriate sowing time is an indispensable agronomic factor for obtaining optimum rice

yields. Keeping this in view, an experiment was conducted in split-plot design with three replications. Four transplanting dates, 9–15 July (D), 23–29 July (D,), 6–12 August (D*f*), and 20–26 August (D,,) in the main plots. Five nutrient management practices in sub-plots, control (N), 100% RDF through chemical sources (N,), 75% RDN through FYM and *in-situ* dhaincha (N*f*), 75% RDN through FYM and dhaincha (supplemented with 25 kg P, O… ha{ ¹) (N,,), and N,, integrated with phosphate-solubilizing bacteria (PSB) application in rice (N…). Growth parameters like leaf area index (LAI) and dry matter accumulation, were recorded at different stage. Rice transplanted during 6–12 August exhibited the highest LAI of 0.72, 2.59, and 3.93 at 30, 60, and 90 DAT and maximum DMA of 201.20, 446.23, 695.63, and 725.49 g m{ ² at 30, 60 and 90 DAT. N5 recorded the highest LAI values (0.73, 2.32, and 3.69 at 30, 60, and 90 DAT) and the greatest dry matter accumulation (191.04, 444.56 and 662.56 g m {²) at corresponding growth stages.

Keywords: *Tulaipanji rice, transplanting time, nutrient management, leaf area index, dry matter accumulation, green manuring*

Development of Drought Tolerant Mulberry Genotypes for Rainfed Sericulture in Jammu region

Santoshkumar Magadum*
Regional Sericultural Research Station, Central Silk Board, Miran Sahib, Jammu, J&K
Corresponding author e-mail: santoshk.csb@gmail.com

Abstract

Mulberry (*Morus* spp.), the host plant of silkworm *Bombyx mori*, is predominantly cultivated as a rainfed crop in India. Drought is the most devastating abiotic stress affecting crop productivity, which is caused by insufficient rainfall and/or altered precipitation patterns. Tolerance to drought is a complex quantitative trait controlled by several small effects and often confounded by differences in phenology. At present, >50% of mulberry cultivation in India in general and >90 % of the North West Indian plantations are being maintained under rainfed hill farming system. This area suffers from moderate to severe degree of water limitation due to irregular rainfall pattern. Therefore, low yields, poor leaf quality and hence low profitability are common in rainfed hill sericulture. The present study comprising nine promising drought tolerant mulberry genotypes *viz*., SM-1, SM-2, SM-3, SM-4, SM-5, SM-6, SM-7, SM-8 and SM-9 along with three check varieties S-146, C-2038 and C-1730 were planted and maintained in Randomized block design at Regional Sericultural Research Station, Central Silk Board, Miran Sahib, Jammu. All the mulberry genotypes were evaluated for various growth, leaf yield and quality parameters during Autumn season 2025 under sub-tropical conditions of Jammu. Analysis of variance for growth and yield contributing characters showed highly significant differences among all the genotypes studied. Among the genotypes, Highest number of new shoots per plant was recorded in SM-6 (11) followed by SM-8 (10) and SM-7 (9) as compared to three check varieties. It has been recorded that leaf yield per plant (kg) was highest in SM-8 (0.538 kg) followed by SM-6 (0.516 kg) and SM-7 (0.432 kg) and were out performing as compared to three check varieties. Number of leaves per meter of shoot was higher in SM-8 (24) followed by SM-6 (22) and SM-7 (21). Similarly, leaf moisture content (%) was highest in SM-6 (73.07 %) followed by SM-8 (72.68 %) and SM-7 (72.34 %) and out performed as compared to three check varieties. Based on this evaluation study, SM-8 and SM-6 drought tolerant mulberry genotypes have emerged as best performing genotypes with respect to different growth,

yield and quality characters as compared to three check varieties, which may be further evaluated under multi-location trials to commercially exploit for production of higher leaf yield and better quality mulberry leaves under rainfed sub-tropical conditions of Northern India.

Keywords: *Drought tolerant, Mulberry, Silkworm, Leaf yield, Rainfed.*

YOLO-Based Instance Segmentation for Multi-Species Weed Detection in Agricultural Fields

Mareeswaran V[1], Sapna Nigam[1*], Madhu[1], Akshay Dheeraj[1], Rajni Jain[2]
[1]ICAR-Indian Agricultural Statistics Research Institute, New Delhi, India
[2]ICAR- National Institute of Agricultural Economics and Policy Research, New Delhi, India
Corresponding author: sapnanigam.iasri@icar.org.in

Abstract

Weed infestation is crucial for effective crop productivity, necessitating precise and efficient segmentation techniques. This study explores the use of YOLO family architectures that are prominent deep learning algorithms for object detection, in agricultural weed segmentation. Recent advancements in deep learning, particularly object detection models such as YOLO (You Only Look Once), offer transformative potential in weed detection and segmentation interpretation. This study presents a comprehensive comparative evaluation of five state-of-the-art YOLO variants—YOLOv8n, YOLOv8s, YOLOv9, YOLOv10, and YOLOv11—for the detection and localization of weeds. Utilizing an annotated dataset of 3W (Weeds in Winter Wheat) public dataset with 6038 images, the models were evaluated based on detection accuracy (mAP@0.5, mAP@0.5–0.95, precision, recall) and inference time per image. Results show that YOLOv11 models significantly outperforms previous YOLO architectures as well as U-Net and Mask RCNN in terms of generalization, and inference speed. YOLOv11 achieved the highest performance with an IoU of 88.7%, a precision of 0.91%, a recall of 0.91% and a DSC of 0.90% and while YOLOv8s and YOLOv8n the were actually good performing models in terms of inference speed. The research confirms that YOLOv12-based instance segmentation as a deployable framework for multi-species weed detection in precision agriculture. It is fast, accurate and robust solutions for automated weed segmentation, laying the groundwork for further deployment in AI-driven weed detection for site specific weed management. This performance is suitable for integration with autonomous ground vehicles or UAV platforms for real time weed detection and mapping.

Keywords: *Weed identification, YOLO architecture, Object detection, Instance segmentation*

Polyhalite-Based Nutrient Management: A Sustainable Strategy for Enhancing Potato Yield, Quality, and Soil Health in the Lower Gangetic Plains of India

Sayani Das* and Soumen Bera
Bidhan Chandra Krishi Viswavidyalaya, West Bengal, India
Corresponding author e-mail: sdasagron@gmail.com

Abstract

Sustainable potato production is significantly impeded by environmental stress, nutrient imbalances, and declining soil fertility. The continuous application of conventional potassium fertilisers, such as muriate of potash (MOP), frequently results in the accumulation of chloride (Cl^-) in soil, which has a detrimental impact on soil health and nutrient use efficiency. In this context, polyhalite, a naturally

occurring chloride-free mineral, provides a balanced multi-nutrient source of potassium (K), calcium (Ca), magnesium (Mg), and sulphur (S). Its slow-release properties guarantee the continuous availability of nutrients, thereby enhancing the efficiency of nutrient use and the long-term fertility of the soil. In order to assess polyhalite as an alternative potassium source in potato cultivation, a two-year field experiment was conducted at Bidhan Chandra Krishi Viswavidyalaya in West Bengal, India, during the *rabi* seasons of 2021–22 and 2022–23. Eight nutrient management treatments were conducted in a randomized complete block design with three replications. The results indicated that the application of recommended quantities of nitrogen and phosphorus, as well as 100% potassium, through polyhalite (T_8) consistently resulted in superior performance compared to conventional and MOP-based fertilisation. The T_8 treatment recorded the maximum aggregated values for plant height (65.96 cm), dry matter accumulation (638.59 g m^{-2}), leaf area index (3.12), average tuber weight (80.08 g), and tuber yield (30.07 t ha^{-1}), as compared to farmers' practice (21.55 t ha^{-1}). This represents a 39.5% increase in yield. In addition, polyhalite-based nutrition significantly enhanced tuber quality attributes, including starch (24.88%), protein (7.14%), amylose (20.96%), total soluble solids (6.76 °Brix), and phenolic content (231.07 mg 100 g{ ¹). Post-harvest soil fertility was also improved, with higher available N (319.29 kg ha^{-1}), P (28.44 kg ha^{-1}), K (233.96 kg ha^{-1}), and S (34.74 kg ha^{-1}). Nutrient uptake and use efficiency were markedly enhanced, with potassium agronomic efficiency reaching up to 115.36 kg tuber kg^{-1} K. Economic analysis further confirmed profitability, with benefit–cost ratios exceeding 2.5 under polyhalite-based treatments. Overall, the study demonstrates that polyhalite is a promising sustainable nutrient source for potato cultivation, capable of improving yield, quality, soil fertility, nutrient-use efficiency, and farm profitability. Its adoption can contribute to resilient and sustainable agricultural systems in the Lower Gangetic Plains and similar agro-ecological regions.

Keywords: *Polyhalite, Potato, Sustainable Nutrient Management, Potassium Fertilization, Soil Health, Nutrient Use Efficiency, Crop Quality, Agronomic Efficiency, Lower Gangetic Plains*

Sustainable Agriculture as a Catalyst for Rural Livelihood Transformation and Poverty Reduction in India

[1*]Shadma Siddiqui, [2]Kundan Singh,

[1]College of Applied Medical Sciences in Al-Namas, University of Bisha,255, Al-Namas City, 67398, Saudi Arabia

[2]Lingaya's Vidyapeeth, Nachauli, Road, Jasana, Faridabad, Haryana 121014, India

****Correspondence Author***

College of Applied Medical Sciences in Al-Namas, University of Bisha,255, Al-Namas City, 67398, Saudi Arabia

E-mail: shadma.10aug@gmail.com, ssiddiqui@ub.edu.sa

Abstract

Agriculture is the backbone of India's rural economy, but it faces the challenge of persistent poverty, resource degradation and climate risks. The study explores the role of sustainable agriculture in transforming rural livelihood and alleviating poverty through diversification, climate resilience and institutional support as conceptualized in the Sustainable Livelihood Framework (SLF).

The study was a descriptive secondary-data analysis to synthesize official datasets and reports from NSSO (2021–2023), NITI Aayog SDG Index (2020–2024), FAO and World Bank (2021–2024), and

Agricultural Statistics at a Glance (2023). We used descriptive statistics and trend analysis to monitor rural poverty, agricultural employment, and the share of agriculture in GDP (2020-2024). We calculated a Livelihood Diversification Index (LDI) to compare regional diversification and assembled adoption rates of key sustainable agricultural practices (SAPs) in 2024. The SLF (natural, social, human, physical, financial capital) directed interpretation of how asset endowments and institutional linkages affect outcomes. Rural poverty declined from 24.2% (2020) to 19.8% (2024), agricultural employment from 44.3% to 39.5% and the GDP share of agriculture increased from 17.6% to 19.0%, indicating productivity gains and structural diversification. LDI was highest in the South (~0.78) and West (~0.74), moderate in the Northeast (~0.68) and North (~0.65), and lowest in the East (~0.55), reflecting differences in infrastructure, market, and institutional context. In 2024, the adoption of SAP showed crop rotation (42.8%), integrated farming systems (33.7%), drip irrigation (25.4%), organic farming (18.2%) and agroforestry (15.6%). Diversification, social capital and access to technology/finance are associated with improved income stability and resilience. Policies (e.g., PM-KISAN, MGNREGA, NMSA, e NAM) and women's collective action (SHGs) strengthened inclusion and market access, though constraints persist in fragmented landholdings, climate shocks, infrastructure gaps, and uneven digital uptake.

Sustainable agriculture, based on diversification, climate change considerations, and institutional innovations, facilitates the reduction of rural poverty and builds resilience. Areas of focus need to include regional considerations, women's empowerment, green technology investments, research-extension interfaces, and digital agriculture.

Keywords: *Sustainable agriculture, Rural livelihoods, Poverty alleviation, Diversification, Climate resilience, Women's empowerment*

Assessment of Indigenous Phosphate-Solubilizing Bacteria for Nutrient Mobilization and Growth Enhancement in Dragon Fruit

Shahil Reza[1]*, Prerna Baraily[2], Aditi Chakraborty[2], Binayak Chakraborty[2] and Rakesh Yonzone[3]

[1]Research Scholar, Department of Pomology and Post Harvest Technology, Uttar Banga Krishi Viswavidyalaya, Pundibari, Coochbehar, West Bengal-736165

[2]Assistant Professor, Department of Pomology and Post Harvest Technology, College of Agriculture (ExtendedCampus of Uttar Banga Krishi Viswavidyalaya), Majhian, Dakshin Dinajpur, West Bengal-733133

[3]Assistant Professor, Department of Plant Pathology, College of Agriculture (Extended Campus of Uttar BangaKrishi Viswavidyalaya), Majhian, Dakshin Dinajpur, West Bengal-733133

Corresponding Author: shahilrezahorti@gmail.com

Abstract

Dragon fruit (*Hylocereus undatus*) has emerged as a valuable fruit crop due to its nutritional qualities and economic importance. However, its cultivation often depends heavily on chemical fertilizers, which raises sustainability concerns, particularly in low-input farming systems. Phosphate-solubilizing bacteria (PSB) provides an environmentally friendly alternative by improving nutrient availability and supporting plant growth through diverse biochemical processes. This study focused on isolating and characterizing native PSB strains from North Bengal region with plant growth-promoting properties. Soil samples

were collected from the rhizosphere of twenty dragon fruit orchards and the bacteria were isolated using serial dilution methods. The isolates were examined for their morphological and biochemical traits. To evaluate their growth-promoting potential tests were conducted for phosphate solubilization, siderophore production, hydrogen cyanide (HCN) release, cellulase activity, biofilm formation, ammonia production, indole-3-acetic acid (IAA) synthesis and antibiotic sensitivity. Initial findings revealed considerable variation among the isolates in their phosphate solubilization capacity and production of beneficial metabolites. Molecular identification using 16S rRNA gene sequencing confirmed the isolates as *Pseudomonas speleai*, *Priestia aryabhattai*, *Acinetobacter* spp, *Bacillus* spp, *Kosakonia sacchari*, *Klebsiella michiganensis* and *Bacillus cereus*. Field trial with application of these isolates showed considerable variation in enhancing nutrient availability and stimulating dragon fruit growth. The study underscores the potential of PSB as a sustainable and eco-friendly substitute for chemical fertilizers, offering benefits such as improved soil fertility, lower production costs and more sustainable dragon fruit cultivation.

Keywords: *Dragon fruit, PSB, Plant growth promotion and 16S rRNA*

Assessing the Combined Influence of Land Use/Land Cover Dynamics and Climate Variability on Landslide Susceptibility Using Geospatial Techniques

Shalini Polakampalli[1]*, Raju Sarkar[2]

[1,2]Department of Civil Engineering, Delhi Technological University, New Delhi-110042, India

Corresponding author e-mail: p.shalini_23phdce503@dtu.ac.in

Abstract

Landslides represent one of the most recurrent and devastating natural hazards in mountainous terrain, and their occurrence is increasingly being modulated by the dual pressures of land use/land cover (LULC) change and climate variability. This study presents a geospatial assessment of landslide susceptibility in a Himalayan watershed (approximately 30°–31°N, 78°–79°E) by integrating multiple geo-environmental conditioning factors using remote sensing and GIS-based multi-criteria evaluation. Seven thematic layers were prepared and analysed: slope, aspect, geomorphology, drainage network density, road network proximity, LULC, and rainfall distribution. The slope map revealed that the majority of the study area is characterised by steep to highly steep gradients, significantly amplifying mass movement potential. Aspect analysis indicated a predominance of north- to east-facing slopes, which influence soil moisture retention and vegetation cover dynamics. Geomorphological mapping identified highly dissected hills and glacial valleys as the dominant landforms, with alluvial plains and glacial moraines constituting secondary units. The LULC map demonstrated a marked spatial dichotomy: dense tree cover in the lower sub-basin contrasts with sparse cropland, shrubland, and snow/ice cover in the upper reaches, with built-up areas and road networks acting as destabilising anthropogenic factors. Rainfall analysis revealed very high precipitation in the southwestern sector and comparatively lower rainfall in the northeastern zone. The final landslide susceptibility map, validated against a historical landslide inventory, classified approximately 30–35% of the watershed as falling under High to Very High susceptibility zones, predominantly concentrated in the northeastern and central sectors where steep slopes, fractured geomorphology, and road disturbance converge. The study underscores the critical role of LULC dynamics and climate-induced rainfall variability in exacerbating landslide hazard, and offers a replicable geospatial framework for climate-resilient land use planning and disaster risk reduction

in ecologically sensitive mountain ecosystems.

Keywords: *Landslide susceptibility, Land use/land cover, Climate variability, Geospatial techniques, GIS, Himalayan watershed*

Identification of ants associated with lac insect in arid western plains of Southern Rajasthan

Sheenam Bhateja[*1], Manoj Kumar Mahla[1] and Hemant Swami[1]

[1]Department of Entomology, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur, 313001, Rajasthan

****Corresponding author e-mail: arorasheenam45@gmail.com***

Abstract

The present study entitled as "Identification of ants associated with lac insect in arid western plains of Southern Rajasthan" was carried out at Lac gene bank cum museum in the Department of Entomology which is maintained for genetic conservation of lac insects under NPCLIGR, Rajasthan College of Agriculture, MPUAT, Udaipur, during 2024 & 2025 with a view to record the different ant species associated with the summer crop of Rangeeni strain of lac insect inoculated on 25th October, 2024 and 20th October 2025 on host *Flemingia semialata* and observations were started 25 days after inoculation and it was continued at fortnightly interval till harvesting of the crop. Ten plants of *F. semialata* were selected randomly and on each plant, fifteen centre meter lac encrustation was measured to record the ant species and their population abundance. The present investigation highlighted the facultative mutualistic association of five ant genus, *viz. Camponotus, Tetraponera, Aphaenogaster, Solenopsis and Anaplolepsis* belonging to three sub-families (Formicinae, Myrmicinae and Pseudomyrmecinae) with lac insect (*Kerria lacca* Kerr) on host plants, *Flemingia semialata*. Out of these, ants of *Anaplolepsis* genus was observed the most abundant and dominated.

Keywords: *Flemingia semialata, Kerria lacca Kerr, Rangeeni strain, Ants, Facultative mutualistic association, Southern Rajasthan*

Oxidative Stress and Tissue Damage Induced by Lead Nitrate in Liver and Muscle of *Channa striatus*

Shivani Sharma[1*], Sadhna Tamot[2], Vipin Vyas[3]

[1*]Department of Fisheries, Pandit Shambhu Nath University, Shahdol (M.P.), India

[2]Department of Zoology, Sadhu Vaswani College, Bairagarh, Bhopal (M.P.), India

[3]Department of Zoology & Applied Aquaculture, Barkatullah University, Bhopal (M.P.), India

****Corresponding author email: shivanifisheries@gmail.com***

Abstract

The study investigates the toxic effects of lead nitrate in liver and muscle tissues, along with oxidative stress biomarkers in the freshwater murrel *Channa striatus*. The objective was to evaluate alterations in lipid peroxidation (LPO) and protein carbonylation (PC), as well as associated histopathological changes under chronic exposure conditions. Healthy specimens of *Channa striatus* (20–25 cm; 50–60 g) were exposed to sublethal concentrations of lead nitrate (8, 18, and 28 mg/L) for 90 days under laboratory conditions. Lipid peroxidation was estimated using the thiobarbituric acid reactive substances (TBARS) assay, while protein carbonyl content was measured as an indicator of oxidative protein damage. Both

liver and muscle tissues were examined for histological alterations. Results revealed a significant, dose- and time-dependent increase in lipid peroxidation and protein carbonylation in treated groups compared to the control. Histopathological analysis showed progressive damage in both tissues, including hepatocyte and muscle fiber degeneration, cytoplasmic vacuolation, structural disorganization, nuclear displacement, and necrotic changes. The findings indicate that chronic lead nitrate exposure induces severe oxidative stress and structural damage in both liver and muscle of *Channa striatus*. The study emphasizes lipid peroxidation and protein carbonylation as reliable biomarkers for assessing heavy metal toxicity in freshwater fish and supports their application in aquatic environmental monitoring.

Keywords: *Channa striatus, Lead nitrate, Oxidative stress, Lipid peroxidation, Protein carbonylation, Histopathology*

Assessment of DAESI course in terms of Extension services performed by input dealers from some socio-economic and management factors

Soma Biswas[1*], Souradeep Chatterjee[2], Asadullah[3]

[1]Assistant Professor, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia,W.B. Pin-741252

[2]Assistant Professor, School of Agriculture and Allied Sciences, Seacom Skills University, Birbhum, Pin-731236

[3]Student, M.Sc(Agril. Extension), Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia,W.B. Pin-741252

*[*]**biswas.soma@bckv.edu.in***

Abstract

The Diploma in Agricultural Extension Services for Input Dealers (DAESI) program aims to bridge the gap between agricultural researchers and farmers by providing input dealers with specialized knowledge and skills for effectively sharing research-based insights. The course has been designed in such a way to train the Input dealers to function as para-extension professionals in their respective areas. The study was conducted in the Birbhum and Purba Bardhaman focusing on the Extension services performed by the DAESI input dealers. The research involved 120 agricultural input dealers, holding DAESI diplomas. Key objectives included assessing the socio-economic profiles of DAESI dealers, The study also explored the extension services rendered by DAESI dealers. A score of dependent variables i.e. Extension Service by Input dealers and 20 independent variables have been executed to study their multilevel interaction to predict and isolate the dominant for DAESI trained respondents. Statistical analysis like coefficient of correlation, stepwise regression analysis was done. The research highlighted that for DAESI trained input dealers, there is a significant correlation between Extension service by Input dealers and different independent variables. Education, business experience and risk orientation have recorded positive correlation. Profit orientation and marketing orientation have recorded significant but negative correlation. From stepwise regression analysis it has been found that out of 20 independent variables 5 variables exert more than 89.37% of total effects Extension service performed by DAESI trained input dealers.

Keywords*: DAESI, input dealers, Extension service, socioeconomic, management, factors.*

Morphological and Structural Insights into Natural and Artificial Agarwood Formation in *Aquilaria malaccensis*: A Valuable Medicinal and Aromatic Plant

Sony Das[1], Supriyo Sen[2], Probin Phanjom[1*]

[1]Department of Bio-Sciences, Assam Don Bosco University, Tapesia Garden, Sonapur, Assam 782402

[2]Royal School of Agriculture, Royal Global University, Tirupati Balaji Temple, Betkuchi, Guwahati, Assam 781035

Corresponding author email: probin.phanjom@dbuniversity.ac.in

Abstract

Agarwood, the highly valued aromatic resinous wood produced by *Aquilaria malaccensis*, is naturally formed through complex biotic interactions involving insects, microorganisms and the tree's defense mechanisms. Due to increasing global demand and reduction of natural resources, artificial methods have been developed for sustainable agarwood production. This study aimed to compare naturally insect-infested and artificially induced agarwood through morphological and structural characterization. Field investigations were conducted in agarwood plantations in Assam, India, focusing on naturally insect-infested trees. These were examined for morpho-phenotypic traits including bore-hole formation, frass deposition, and growth parameters. *Neurozerra conferta* (Lepidoptera: Cossidae) was the most frequent associate, causing tissue damage and triggering resin production. Simultaneously, trees artificially induced with a proprietary herbal formulation through saline injection were evaluated for resin zone development. Structural and chemical characterization was performed using Scanning Electron Microscopy (SEM), Fourier Transform Infrared Spectroscopy (FTIR), and phytochemical analyses. Natural agarwood samples showed characteristic bore holes and frass deposits, indicating insect association during resin formation. Artificially induced samples developed distinct resin zones with mean sizes ranging from 10.16–18.21cm. FTIR analysis revealed phenolic, aromatic, aliphatic, and oxygenated functional groups associated with resin-related secondary metabolites. SEM analysis showed marked microstructural differences between induced and control samples, including denser tissue organization, reduced pore spaces, deposition-like materials, and variations in cell wall thickness. Agarwood resin is a valuable source of bioactive compounds with applications in medicine and fragrance. These compounds are used in traditional healing, the perfume industry, and modern pharmacology. Its therapeutic properties are attributed to phenolics, terpenoids, and aromatic hydrocarbons, which exhibit antimicrobial, anti-inflammatory, and antioxidant activities. Its fragrance components also contribute significantly to the global perfume market. This comparative approach provides preliminary insights into natural and artificial agarwood formation, supporting strategies for sustainable production, fragrance enhancement, and medicinal utilization in *A. malaccensis*.

Keywords*: Aquilaria malaccensis, Agarwood induction, Neurozerra conferta, Insect infestation, SEM, FTIR.*

Shifts in cropping pattern in the Hill Zone of North Bengal: Trends, dynamics and livelihood implications

Soumyadeep Das[1]* and Kalyan Kanti Das[1]

[1]Department of Agricultural Economics, Uttar Banga Krishi Viswavidayalaya, Pundibari, Cooch Behar, West Bengal-736165

*Corresponding address: Soumyadeep Das, Senior Research Fellow, Department of Agricultural Economics, Uttar Banga Krishi Viswavidayalaya, Pundibari, Cooch Behar, West Bengal-736165
(Email: dassoumyadeep663@gmail.com)

Abstract

The Hill region of North Bengal, characterised by the cool humid climate, high intensity of rainfall and steep topography with small fragmented land holdings, has undergone a gradual but noticeable shift in cropping pattern from 2000-01 to 2022-23. The percentage of total foodgrains in total cropped area dropped significantly from 73.05 to 53.33 percent, which is a shift away from traditional subsistence agriculture based on cereals. Within cereals, the area under kharif paddy increased from 45.55 percent to 67.61 percent, whereas the area under traditional crops like ragi and wheat saw drastic falls from 18.82 per cent to 4.94 per cent and from 5.24 percent to 1.11 percent, respectively. At the same time, the area under vegetables increased significantly from 21.34 to 42.13 percent of the total area under cultivation, reflecting the growing commercialisation and diversification toward high-value crops. Potato and tobacco areas have more than doubled during rabi, reflecting a desirable shift of crop substitution to more profitable ventures. The diversification analysis also shows the gradually decreasing Simpson Index values from 0.8020 in 2000–01 to 0.6559 in 2022–23, indicating the growing concentration of crops and selective specialisation. The growth analysis further indicates negative CAGR in total cereal acreage (-3.08%) and positive growth in vegetables (2.79%) and oilseeds (3.06%) further indicating the move towards market-oriented agriculture. These changes have been primarily driven by the profit-making motive, market integration, technological interventions, and optimising returns from limited cultivable land. Overall, the Hill zone shows a clear process of transition with agriculture still playing a predominant role in livelihoods, but increasingly focusing on high-value and commercially viable crops under ecological constraints.

Keywords: *Shifts, cropping pattern, decadal trend, livelihood options, Hill zone, North Bengal*

Experimental Study of Droplet Spreading and Retention on Banana Leaf Surfaces

Hasan Vohra, Devanshi Kaushik, Nandan Kusumgar, Sumit Tripathi*
Institute of Infrastructure, Technology, Research and Management (IITRAM) Ahmedabad, 380026, India
Corresponding author e-mail: tripsumit@gmail.com

Abstract

The role of droplet impact on the plant leaf surface is significant in agriculture, spray applications, pesticide adsorption, and fertilization processes. In this work, experimental studies are performed to examine the impact response of oil, water, and emulsion droplets on the surface of banana leaves. The droplets were released through a blunt-tip needle from heights of 10, 15, and 20 cm, and the effects of droplet velocity impacting the banana leaf surface was analysed. The experiments indicated notable differences in the behaviour of the three liquids on leaf surface. Droplets of pure water were found to have less spreading because of their relatively high surface tension. Oil droplets demonstrated better wetting and spreading because of low interfacial tension and hence better retention. Droplets of emulsion possessed properties between those of pure oil and water. Increase in release distance from 10 to 20 cm led to higher impact speed and consequently bigger spreading diameter. These results emphasize the significance of formulation in liquid form and the conditions under which the impact occurs. This study

offers valuable information on the proper formulation and application of pesticides and bio-fertilizers, thereby reducing unnecessary chemical wastage and ensuring minimal environmental pollution.

Keywords*: Droplet impact, Banana leaf surfaces, Oil-water emulsion, Agricultural spraying*
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"Synergistic Integration of Digital Tools and Nano Technology : A Paradigm Shift in Biotic and Abiotic Stress Management"

Sunanda Barman[1]* & Anindita Saha[2]
Ph.D. Scholar, Department of Agricultural Extension, Palli Siksha Bhavana , Visva - Bharati University, Sriniketan - 731236, West Bengal
Associate Professor, Department of Agricultural Extension, Palli Siksha Bhavana , Visva - Bharati University, Sriniketan - 731236, West Bengal
Corresponding author email id : sunandabarman121998@gmail.com

Abstract

Climate change accelerates biotic and abiotic stressors that cause 30 – 50% production losses I agriculture worldwide. Conventional management is spatially inaccurate, resource intensive and reactive. Real-time stress detection, predictive modeling, and site-specific interventions have been rendered possible by digital tool such as Big Data Analytics, AI & Machine Learning, Remote Sensing, Drones and Precision Farming. This is complemented by nanotechnology, which includes nano-priming for improved crop tolerance, nano-biosensors for early stress signaling, and tailored pesticide administration. AI-processed drone photography can initiate variable-rate application of nano-formulated inputs, increasing input utilization efficiency >90% while lowering environmental load. This convergence produces transformative synergy. The key challenges and constraints contributes to data interoperability, nano-regulatory frameworks and assuring smallholder access. By addressing these obstacles, the paradigm can be established by aligning SDGs 2, 9 and 13 promoting climate resilient agriculture. This study demonstrates how the harmonious integration of digital tools and nanotechnology can lead towards a proactive and precise stress management.

Keywords: *Climate change, AI, Nanotechnology, Stress, Management, Precision farming.*

Mesoporous Silica Nanocarrier Enhances Anti-Dyslipidaemia Potential of Solanum torvum

Mrs. Swati Ravindra Borse
Sandip University, Nasik, Maharashtra, India. (Pharmaceutical Science)- 422213

Abstract

Diabetic dyslipidaemia is a major contributor to cardiovascular complications in diabetes mellitus. The present study aimed to develop and evaluate a mesoporous silica nanoparticle (MSN)-based delivery system of Solanum torvum extract (STE) and investigate its therapeutic potential with special emphasis on lipid profile modulation in streptozotocin (STZ)-induced diabetic rats. Diabetes was induced by a single intraperitoneal injection of STZ (60 mg/kg). Animals were treated orally for 28 days with STE,

STE-MSNs, STE-MSNs tablets, or Metformin (500 mg/kg). STE-MSNs demonstrated significant correction of diabetic dyslipidaemia, reducing total cholesterol (35%), triglycerides (47.5%), LDL-C (55%), and VLDL-C while increasing HDL-C (53%) compared to diabetic control. The nano formulation also improved glycemic control, hepatic and renal biomarkers, and antioxidant enzyme activities. Histopathological findings confirmed protection of pancreatic architecture. The results indicate that nano-encapsulation markedly enhances the cardiometabolic protective efficacy of Solanum torvum, positioning STE-MSNs as a promising therapeutic strategy for diabetic dyslipidaemia and its associated complications.

Keywords: *Diabetic dyslipidaemia, Mesoporous silica nanoparticles, Solanum torvum, Lipid profile, Cardio protection, STZ-induced diabetes*

Enhancement of Ghee Stability Using Plant-Derived Phenolic Antioxidants: Oxidative, Thermal and Digestive Perspectives

Tanmay Hazra, Kunal Kumar Ahuja, Rohit Sindhav, Bhavbhuti Mehta, Manish Parmar
College Of Dairy Science, Kamdhenu University, Amreli, Gujarat- 365601
th@kamdhenuuni.edu.in

Abstract

Lipid oxidation is a critical factor affecting the shelf life and quality of ghee, necessitating the exploration of plant-based antioxidant approaches. This study evaluated the efficacy of natural antioxidants from Jamun Seed and Nutmeg in enhancing the oxidative stability, thermal stability, and functional properties of ghee. Antioxidant incorporated ghee samples were analyzed for radical scavenging activity using DPPH and ABTS assays, oxidative stability through induction period, and thermal stability during frying. Additionally, physicochemical parameters, fatty acid composition (GC–MS), and triacylglycerol (TAG) profile were assessed to determine any compositional changes. The results demonstrated a considerable enhancement in antioxidant activity and a substantial increase in induction period (2-fold) in antioxidant incorporated ghee compared to control. Although antioxidant activity reduced following in-vitro digestion and frying, treated samples retained considerably higher activity than control, indicating partial stability and bio accessibility of phenolic compounds. Peroxide formation during frying was notably reduced, confirming improved oxidative stability under thermal conditions. Importantly, no notable changes were observed in physicochemical properties, fatty acid composition, sterol profile, or TAG distribution, confirming authenticity of ghee. The findings demonstrate that incorporation of Jamun Seed as plant based clean-label antioxidants is an effective approach to develop functional or herbal ghee with enhanced shelf life, improved frying stability, and potential for industrial application.

Keywords*- Antioxidant, Digestive, Frying, Oxidative Stability, Induction Period*

Women's Voices in Climate Services: KPA Dynamics among Farm Women

Tannistha Majee* and Kausik Pradhan
Department of Agricultural Extension, Uttar Banga Krishi Viswavidyalaya
Pundibari, Coochbehar, West Bengal- 736165, India
****Corresponding author e-mail: majeetannistha@gmail.com***

Abstract

Agriculture is the backbone of India's rural economy, employing over 45% of the workforce and contributing approximately 18% to the national GDP as of 2025. In Indian agriculture, women play a vital role in terms of crop production and providing workforce. Recent Periodic Labor Force Survey (PLFS) 2024 data shows women constitute over 42% of India's agricultural workforce. Women are estimated to grow about 50% of the world's food. But whenever it comes to decision making, they are always dependent on the male members of their family. As a result, Recent FAO survey found that women own only 2% of the land, receive 1% of agricultural credits and 5% of all agricultural extension resources. By focusing several issues, this research work framed. Coochbehar and Alipurduar districts of West Bengal were selected purposefully because this area highly vulnerable to climatic risks. This study focuses on assessing how much farm women know about climate information services, how they perceive their usefulness, reliability and accessibility and what attitude they hold towards adopting and utilizing such services in their farming decisions. It helps to understand their level of awareness, understanding and acceptance of climate services. Knowledge, perception and attitude were considered as the predicted variable in the present study. A set of other 17 predictor variables were considered to characterize the predicted variables in the perfect way. All these variables were operationalized and measured with the help of the slightly modified pre-constructed and tested scales. Farm women will be more empowered not only in terms of economically but also psychologically and socially. And also, they can become the decision maker instead of laborers at their own farm.

Keywords: *Attitude, Climate change, Climate information service, Farm women, Knowledge, Perception*

Insights into waterlogging tolerance in sugarcane through functional genomics

Thamilarasi K[1]*, Ilakiya B[1], Prathima PT[1], Manimekalai R[1], Gomathi R[2] and Selvi A[1]

[1]Crop Improvement Division, ICAR-Sugarcane Breeding Institute, Coimbatore – 641007, Tamil Nadu, India

[2]Crop Production Division, ICAR-Sugarcane Breeding Institute, Coimbatore – 641007, Tamil Nadu, India

***Corresponding author e-mail: kthamilarasi@gmail.com**

Abstract

Waterlogging in sugarcane is an emerging abiotic stress reducing the yield to a tune of up to 45%. To study the mechanism of waterlogging tolerance in sugarcane varieties, a tolerant (Co 62175) and a susceptible sugarcane variety (Co 86032) were subjected to waterlogging stress. Waterlogging stress was imposed on potted plants at the sixth month of growth by immersing the pots in tarpaulin bags filled with water, maintained at 30 cm above the soil surface, for a period of four weeks. Biochemical and physiological parameters were studied at weekly intervals, and transcriptome sequencing of these varieties was conducted after a month. Protein content increased in all the varieties after waterlogging. Nitrate reductase activity increased in the tolerant variety after waterlogging, but decreased in the susceptible variety. Shoot length, root length, and number of aerial roots increased substantially in the tolerant variety under waterlogging.

Transcriptomes of the waterlogging-tolerant (Co 62175) and susceptible (Co 86032) sugarcane varieties were sequenced using the Illumina platform for the first time. High-quality reads obtained were from 14 to 22 million reads. These reads were assembled into a total of 369,424 transcripts, from which

100,101 CDS were predicted. 83% of the total CDS (83,202) were able to be functionally annotated by BLAST analysis. Differential gene expression (DEG) analysis of the CDS between control and treated samples revealed the upregulation of putative waterlogging-tolerant genes such as ethylene-responsive transcription factor, alcohol dehydrogenase, aldehyde dehydrogenase, catalase, peroxidase, and superoxide dismutase in treated samples compared with control samples. The complete CDS of *erf* (1081 bp) from the waterlogging-tolerant variety Co 8371 and *acco* (1075 bp) from Co 11015 were cloned and sequenced.

Keywords: *sugarcane, waterlogging, transcriptomics, gene cloning*

Genotype × Environment interaction and stability analysis of baby corn hybrids for grain yield using AMMI and GGE Biplot

Yathish, K.R[1*]., Santosh Kumar[2]., Pardeep K[3]., Susmita C[1] and Sunil N[1]

[1]Winter Nursery Centre, ICAR-IIMR, Hyderabad-500030, India

[2]ICAR-Indian Agricultural Research Institute, Gaurikarma-825405, India

[3]ICAR-Indian Institute of Maize Research, Ludhiana-141004, India

****Corresponding author email: kr.yathish@icar.org.in***

Abstract

In response to the growing demand for baby corn, the development of dual-purpose hybrid varieties with both high yield potential and genetic stability is critical to ensure consistent production across multiple growing seasons. Accordingly, the present study aimed for multi-location testing of ninety-two baby corn hybrids along with three checks in two replications across three environments *viz.,* Hyderabad, Ludhiana and Hazaribagh during *rabi*, 2022-23. Analysis of variance highlighted the significant impact of genotype (G) and environment (E), for days to 50% silking; whereas significant effect of environment was noticed for the trait baby corn yield (BCY) without husk and significant effect of both environment and GE interaction was noticed for BCY with husk. The environment remained as the most important source of variation for all the traits, followed by GE (0.09-0.89%) and G (0.22-0.82%). The first two principal components explained 89.88%, 77.46% and 77.08% of the total variation for DS, BCY without husk and BCY with husk, respectively. Classification of the three locations into three distinct mega-environments revealed no relationship between the environments tested, which means genotypes that performed well in one environment might exhibit poor performance in another and *vice-versa*. Based on the GGE biplot and AMMI analysis, genotypes T81, T64 and T26 exhibited superior performance and stability across all the three locations for BCY without husk.

Keywords: *AMMI, Baby corn, Environment, GGE biplot, Stability, Yield*

Studies on heterosis for growth and yield in tomato under foothill condition of Nagaland

Ajeet Kumar*[1], S.P. Kanaujia[1], Sentirenla Jamir[1] and Raj Kumar[2]

[1]Department of Horticulture, School of Agricultural Sciences, Nagaland University, Medziphema Campus, India.

[2]Department of Vegetable and Spice Crops, Uttar Banga Krishi Vishwavidyalaya, Coochbehar, West Bengal - 736165, India.

Abstract

The present investigation was carried out during 2023-24 and 2024-25 at the Experimental Research Farm, Department of Horticulture, SAS, Medziphema Campus, Nagaland University to estimate standard heterosis in tomato. In the first year, seven lines and three testers were planted in a crossing block and crossed using a line × tester matting design. In the second year, parents, crosses and checks were planted under Randomized Block Design. The assessment of standard heterosis over two checks C_1 (Arka Rakshak) and C_2 (Arka Abhed) revealed significant effects among the cross combinations for growth, yield traits. For plant height, the cross EC-620424 × Kashi Anupam exhibited the highest heterosis (71.34% and 67.08% over C1 and C2, respectively). Earliness in terms of days to 50% flowering was best expressed by Pusa Ruby × Azad T-5, recording maximum negative heterosis (-25.19% and -32.87%). Among yield components, Punjab Chhuhara × Azad T-5 was superior for fruits per cluster (42.21% and 27.68%). The maximum heterosis for fruits per plant was observed in Punjab Chhuhara × Kashi Anupam (77.16% and 65.19%). For average fruit weight were highest in Kashi Aman × Pusa Rohini (27.76% and 25.59%, respectively). Notably, the highest fruit yield per plant was recorded in Kashi Aman × Pusa Rohini (71.44% and 57.14%). The superior hybrids identified, particularly Kashi Aman × Pusa Rohini, may be exploited directly for hybrid cultivation and can also serve as promising parental material in future breeding programmes aimed at improving yield and related traits in tomato.

Keywords: *Tomato, standard heterosis, hybrid, growth and yield.*

Economic Analysis of Processing of Traditional Mishti Doi (Sweet Curd) – A Potential Dairy Product in Terai Region of West Bengal, India

Akash Biswas[1] & Ashutosh Sarkar[2]
Department of Agricultural Economics, UBKV, Coochbehar, Pin-736165, India
Corresponding author email: abiswas301997@gmail.com

Abstract

Mishti Doi, a traditional fermented sweet curd from Bengal, is essential constituent to traditional milk-based value chain in Terai Region of West Bengal. Despite its importance, there is limited research on its commercial production. This study examines 31 traditional processing units across four Terai blocks—Coochbehar-II, Tufanganj-I, Alipurduar-I, and Alipurduar-II—using data collected from April 2024 to March 2025. On average, each unit processes about 148.51 litres of milk per day, producing 124.66 kg of curd, which sells for Rs 123.82 per kg. The cost structure is composed of fluid milk, making up 59.65% of the total variable cost (Rs 46.31 per kg), with regional procurement prices varying between Rs 36.61 and Rs 42.91 per litre, significantly impacting profitability. The total cost per kg of output ranges from Rs 71.84 to Rs 86.35 across the different blocks. All units are financially viable, with an average net profit of Rs 46.19 per kg, a benefit-cost ratio (BCR) of 1.61, and a profit margin of 37.90% on total variable costs. Coochbehar-II stands out with a BCR of 1.71 and a margin of 42.33%, while Alipurduar-II has the lowest margin at 30.87%. Market concentration shows a moderate overall structure (CR4: 59.79%; HHI: 1,351), with low Gini coefficients (0.07–0.15) indicating a fair distribution of market share among existing players. Seasonality indices reveal that production peaks during the festive months from September to December (SI: 112.57%) and dips during the monsoon season (SI: 89.52%).

The said dairy value chain is perpetually sustainable in regional food habits. Still, it needs to be augmented by smart packaging that may increase product shelf life with the scope of market expansion beyond the existing territory.

Keywords: *Misti Doi, Sweet curd, Processing, Traditional, Production, Smart packaging.*

Selection for yield and quality attributing traits of pea (*Pisum sativum* L.) genotypes

Anamika Kharka[1*], Laxuman Sharma[2]

[1]PhD Scholar, Department of Horticulture, Sikkim University, Gangtok, Sikkim, 737102, India

[2]Professor, Department of Horticulture, Sikkim University, Gangtok, Sikkim, 737102, India

Corresponding author e-mail: anakharka1996@gmail

Abstract

The cultivated peas are potential high- yielders, yet comprehensive genetic analysis of local landraces in Sikkim have remained somehow unexplored. This study was undertaken at Department of Horticulture, Sikkim University, to evaluate the genetic diversity and yield potential of local pea genotypes to identify superior lines and parent material for future breeding programs. A total of 52 genotypes – comprising 42 local collections gathered across Sikkim alongside GPS data, 6 external genotypes, and 4 check varieties were evaluated. In the first year, all genotypes were grown using Augmented design to analyze the morphological characters complemented by molecular profiling via PCR using 50 Simple Sequence Repeat (SSR) markers. Marker polymorphism was quantified using binary scoring (1 for presence and 0 for absence) to develop similarity matrices, and a dendrogram was generated using NTSYS-pc 2.01 software. Based on cluster analysis, 32 genetically distinct, high yielding genotypes were selected and evaluated in an Augmented design during the second year. In the third year, the final 13 high yielding genotypes were advanced to Randomized Block Design (RBD) trial alongside the 4 check varieties. The agro-morphological results demonstrated that several local genotypes exhibited yield performance at par with the standard check varieties. This investigation provides valuable insights into the identification of potential Sikkim's Local pea germplasm. The identified genotypes can be strategically utilized as valuable parental lines in future hybridization and crop improvement programs aimed at enhancing sustainable pea production in the region.

Keywords: *Pisum sativum, Local genotypes, Genetic Diversity, SSR Markers, Augmented Design, Crop Improvement*

Characterization and Performance Evaluation of Selected Ornamental Kale Genotypes (*Brassica oleracea* var. acephala Dc.)

[1]Anushree Das*, [2]Tapas Mandal

[1]PhD Scholar, Department of Floriculture, Medicinal and Aromatic Plants, Faculty of Horticulture, Uttar Banga Krishi Viswavidyalaya (UBKV), Pundibari, Cooch Behar, West Bengal, India

[2]Professor, Department of Floriculture and Landscaping, Faculty of Horticulture, Bidhan Chandra Krishi Viswavidyalaya (BCKV), Mohanpur, Nadia, West Bengal, India

Corresponding author's e-mail: anushreedas1224@gmail.com

Abstract

Ornamental kale (*Brassica oleracea* var. *acephala* Dc.), a member of the family Brassicaceae, is a popular cool-season ornamental plant valued for its attractive foliage displaying vibrant shades of pink, purple, red, white, and multicolour patterns, often bordered by green margins. Originating from the Mediterranean region, it is characterized by rosette-shaped leaves and is widely used in winter gardening, landscape design, and cut flower arrangements. Owing to its tolerance to temperature fluctuations associated with recent climate change, ornamental kale has gained popularity among European growers. Its adaptability also makes it suitable for winter gardening in the plains of West Bengal. Therefore, evaluation of available genotypes based on morphological, quality, and biochemical traits is essential for identifying suitable cultivars for commercial cultivation and landscape use. Ten ornamental kale genotypes obtained from AICRP on Floriculture, Kalyani, namely KtOK-21, KtOK-32, KtOK-37, Crane Red, KtOK-66, KtOK-3, KtOK-2-1, Nagoya F1 Hybrid Mix, KtOK-4, and KtOK-1, were evaluated to identify superior varieties for winter gardening in the plains of West Bengal. Observations were recorded on plant height, plant spread, stem length, stem diameter, head size, coloured portion diameter, days to head and colour formation, head retention duration, vase life, chlorophyll content, and anthocyanin content.

Significant variability was observed among the genotypes. G4 (Crane Red) exhibited superior plant height (60.09 cm), canopy spread (42.93 cm), and anthocyanin content (15.94 g mg{ ¹), while G8 (Nagoya F1 Hybrid Mix) produced the largest head size (8.93 cm) and most vivid coloured portion. G1 (KtOK-21) recorded the longest vase life (5.33 days) and highest chlorophyll content (12.22 g mg{ ¹). In contrast, G5 (KtOK-66) performed poorly for most traits. The study revealed substantial genetic variability, with G1, G3, G4, G6, and G8 identified as superior genotypes for ornamental value, quality attributes, and adaptability. These genotypes are recommended for landscaping and cut flower use, contributing to diversification of winter floriculture in West Bengal.

Keywords: *ornamental kale, genotype evaluation, morphological traits, anthocyanin content, chlorophyll content, landscape gardening.*

Colour space analysis - A potential tool to aid classification and selection of new gladiolus genotypes

Arpita Mandal Khan[1*] and Oendrilla Chakraborty[2]

[1]Assistant Professor, Department of Floriculture, Medicinal and Aromatic Plants

[2]Research Scholar, Department of Floriculture, Medicinal and Aromatic Plants

Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar

****Corresponding author mail id: arpita@ubkv.ac.in***

Abstract

Flower colour is the most important identifier of flower varieties. Gladiolus, known as the queen of bulbous flowers, is highly demanded in cut flower trade due to having diverse range of striking spike colours. To create a systemic method to assess colour variation in Gladiolus, a study was conducted during 2023 to 2025 in the Department of Floriculture, Medicinal and Aromatic Plants, Uttar Banga Krishi Viswavidyalaya using nine parent Gladiolus genotypes and eighty eight crosses generated from the cross of those nine parents. Based on DUS testing guidelines of Gladiolus, as suggested by PPV&FRA,

the primary colour of the flower and the inner tepal: major macule colours were noted by comparing them with RHS colour chart. The Royal Horticultural Society Colour Chart edition 5th provided the RGB colour space values of the respective hues, which were subsequently transformed into L*a*b* colour space values using the website's online converter. Then Hierarchal cluster analysis and principal co-ordinate analysis were performed based on L*a*b* colour space values of the ninety-seven genotypes. According to UPGMA cluster analysis on flower main colour two major clusters were formed and based on Inner tepal: macule colour three major clusters were formed. This study revealed significant flower colour variation, indicating high heterozygosity and genetic diversity in Gladiolus. The genotypes were categorized into eight primary colour groups from the RHS colour chart, including white, yellow, violet, and purple-red. This diversity was evident in both the main tepal colour and the inner tepal macule, underscoring the impact of genetic background on floral pigmentation.

Keywords: *Flower main colour, Inner tepal: macule colour, Gladiolus, UPGMA cluster analysis, L*a*b* colour space, RHS colour chart*

Screening for Heat Tolerant Genotypes in Bread Wheat (*Triticum aestivum L.*) using Stress Tolerance Indices

Arpita Singh Tomar* Gideon Synrem Sharad Pandey*****

*,**School of Agriculture, Forestry and Fisheries, Jigyasa University, Dehradun – 248197 Uttarakhand, India

***Professor, School of Agriculture, Uttaranchal University, Dehradun – 248007. Uttarakhand

Corresponding Author: Arpita Singh Tomar, email: arpitatomar.tomar@gmail.com

Abstract

Terminal heat stress is one of the major abiotic constraints limiting wheat productivity under changing climatic conditions. The present investigation was conducted at research farm of Jigyasa University to evaluate 32 bread wheat (Triticum aestivum L.) genotypes under timely sown and late sown environments (2024-2025) for identification of heat tolerant genotypes using yield based stress indices and heat map analysis. Significant variation was observed among the genotypes for grain yield and all heat tolerance indices, indicating substantial genetic variability for heat stress tolerance. Grain yield under timely sown conditions ranged from 4.91 to 8.80 g plant{ ¹ with a mean of 6.32 g plant{ ¹, whereas under late sown conditions it ranged from 4.49 to 6.10 g plant{ ¹ with a mean of 5.11 g plant{ ¹, resulting in an overall yield reduction of 19.15% under terminal heat stress. Different stress indices including Stress Tolerance Index (STI), Tolerance Index (TOL), Mean Productivity (MP), Geometric Mean Productivity (GMP), Harmonic Mean (HM), Yield Stability Index (YSI), Stress Susceptibility Percentage Index (SSPI), Relative Stress Index (RSI), Mean Relative Performance (MRP), and Percent Yield Reduction (PYR) were evaluated for identification of stable genotypes. Genotypes HI1634, MP3336, HD3086, GW463, and DBW303 exhibited superior performance under both stress and non-stress conditions and were identified as promising heat tolerant genotypes based on higher STI, GMP, MP, HM, and MRP values coupled with lower TOL and PYR values. . The identified superior genotypes may serve as valuable donor parents in future breeding programmes aimed at developing climate resilient wheat cultivars suitable for late sown and terminal heat stress environments.

Keywords: *Heat stress, wheat, timely sown, late sown, stress indices, genotype stability, climate resilience*

Comparative Assessment of Career Aspirations among Agricultural Students of Public and Private Universities in West Bengal: Implications for Human Capital Development and Sustainable Livelihood Security

[1]Atreyee Sarkar, [2]Litan Das [1]Avirup Das

[1]*Ph.D. Scholar, [2]Assistant Professor, Department of Agricultural Extension, Uttar Banga Krishi Viswavidyalaya, Pundibari, Coochbehar-736165, West Bengal, India

Corresponding author mail id: atreyee289@gmail.com

Abstract

India's youth constitute a vital national resource, and understanding their career aspirations is particularly important for a sector like agriculture, which continues to play a crucial role in the national economy by contributing nearly 18.3 per cent to India's Gross Value Added. With the expansion of agricultural education and increasing diversification of career opportunities, it has become important to assess the aspirations of agricultural students and the factors shaping their future career choices. In this context, the present study was undertaken to examine the level of career aspirations of agricultural students in West Bengal. The study was conducted across six agricultural universities, comprising three public and three private institutions located in different districts of the state. Universities were selected through purposive sampling, and a total sample of 120 respondents was selected using simple random sampling. An ex-post facto research design was employed; data was collected using a structured interview schedule and analyzed using appropriate statistical tools. The results showed that agricultural students had significant aspirations for higher education, job opportunities, entrepreneurship, social progress, and economic prosperity. Students attending public universities showed comparatively higher educational aspirations, while those at private institutions exhibited more interest in self-employment and social aspiration. Nonetheless, both groups exhibited comparable degrees of job, economic, and overall career aspirations, indicating a shared ambition for professional development and improved livelihood. Achievement motivation, ICT competencies, exposure to mass media, access to career information, and entrepreneurship education surfaced as significant elements influencing students' ambitions and career decisions. The research emphasizes the importance of enhancing career counseling, fostering entrepreneurship, improving digital skills, and promoting experiential learning in agricultural education. These initiatives can cultivate a skilled agricultural workforce prepared for the future, capable of enhancing sustainable livelihood security and facilitating rural transformation.

Keywords: *Agricultural Students, Career Aspirations, Public and Private Universities, Career aspiration, Human Capital Development*

Evaluation of Dahlia (*Dahlia variabilis L.*) cultivars following DUS guidelines in the Terai region of West Bengal

Ayan Pradhan

Research Scholar, Department of Floriculture and Landscaping, Faculty of Horticulture, Uttar Banga Krishi Viswavidyalaya (UBKV), Pundibari, Cooch Behar, West Bengal, India

Corresponding author's e-mail: ayanpradhan2000@outlook.com

Abstract

Dahlia (family Asteraceae) is one of the most important ornamental flowers worldwide, valued for its diverse forms, vibrant colours, and versatility in landscaping, exhibitions, floral decorations, and cut-flower arrangements. Dwarf cultivars are suitable for beds and borders, while large-flowered types enhance terraces and verandas. Pompon and miniature dahlias are especially popular due to their long-lasting freshness. Besides ornamental value, dahlia tubers contain inulin, phytin, benzoic acid, and bioactive compounds such as butein-4-glucoside, which possess antioxidant, anti-inflammatory, and anticancer properties. Characterization of indigenous germplasm is essential for crop improvement, conservation of genetic resources, and maintenance of biodiversity. In India, the Protection of Plant Varieties and Farmers' Rights (PPV&FR) Act, 2001 provides legal protection to new plant varieties and encourages investment in plant breeding. Characterization also helps identify distinct genotypes and avoid duplication. Qualitative traits, being controlled by one or a few major genes and less influenced by environmental factors, are generally more stable and reliable for genotype identification than quantitative traits. Under the PPV&FR Act, varieties must meet the criteria of Distinctness, Uniformity, and Stability (DUS), emphasizing the importance of characterization using DUS descriptors. Accordingly, the present study was conducted at the FMAP Instructional Farm, Uttar Banga Krishi Viswavidyalaya, Cooch Behar, West Bengal, during the winter season of 2025–26 to characterize forty-five dahlia genotypes using qualitative descriptors prescribed under DUS guidelines. Considerable variability was observed among genotypes in both vegetative and floral traits, including differences in inflorescence colour, shape, size, and form. Among the evaluated cultivars Dust Stone, Jyotsna, Ketu, Tenzing Norgay, Nusrat were found particularly promising for the Terai region of West Bengal owing to its distinctive characteristics and ease of growing.

Keywords: *Dahlia, Asteraceae, PPVFR, DUS, Biodiversity, Qualitative*

Navigating the "Socio-Ecological Funnel": Drainage Fragmentations, Precarious Out-Migration, and Water-Resilient Livelihood Transitions in the Gangetic Plains.

Blessed Mashonganyika[1*], VS Ramachandran[2]

[1]Amrita School for Sustainable Futures, Amrita Vishwa Vidyapeetham, Kollam, 690525, Kerala, India.

[2]Centre for Environmental Studies, Amrita Vishwa Vidyapeetham, Coimbatore, 641112, Tamil Nadu, India.

Corresponding Author Email:
am.id.r4ids23013@am.students.amrita.edu;blessedmarshy90@gmail.com

Abstract

Lowland agroecosystems in the Gangetic Plains face a chronic, "locked-in" socio-ecological crisis characterised by monsoon waterlogging and escalating thermal stress. In Krishnarampur village, West Bengal, recurrent Kharif paddy failures have severely disrupted traditional farming systems, triggering significant male out-migration for precarious off-farm urban labour. This study employs a multi-tiered "Socio-Ecological Funnel" design to investigate how intersecting climatic variability and anthropogenic landscape alterations disrupt local livelihood security. Preliminary spatio-temporal analysis of Land Use Land Cover (LULC) dynamics and rainfall variability reveals a critical hydrological paradox: while 30-year Indian Meteorological Department data (1996–2025) show a slight, statistically significant

decline in total annual precipitation, local inundation depths and waterlogging durations have paradoxically increased. High-resolution LULC mapping (2017–2024) confirms that this heightened flooding is driven by severe anthropogenic drainage obstructions and fragmented hydrological connectivity, resulting from built-up expansion and rural infrastructure development, rather than purely meteorological factors. This spatial baseline serves as a diagnostic gatekeeper for ongoing mixed-method empirical field interventions, including extensive household surveys (N = 221) capturing migration dynamics, hydro-chemical soil-water testing, and crop-specific CROPWAT modelling to assess localised hydrological risks. Ultimately, this research validates a unified, nature-based decision-support framework designed to transition vulnerable communities from rigid, climate-vulnerable dependency on paddy to water-resilient, diversified livelihood streams. By strategically leveraging "monsoon utility" through targeted interventions like vertical mushroom farming and integrated aquaculture, this study provides a scalable, policy-relevant roadmap to enhance adaptive capacity, maximise food security, empower women's self-help groups, and mitigate forced rural-urban labour migration in fragile deltaic environments.

Keywords: *Socio-ecological resilience, Drainage fragmentation, Livelihood diversification, Climate-induced migration, Gangetic Plains.*

Screening of Rice Genotypes for Resistance to Sheath Blight caused by *Rhizoctonia solani* in Eastern India

Burri Rachel*[1], Ayon Roy[1], Prateek Madhab Bhattacharya[1], Rupsanathan Mondal[2]

[1]Department of Plant Pathology, Uttar Banga Krishi Vishwavidyalaya, Pundibari, Cooch Behar, 736165 West Bengal (India)

[2]Department of Plant Breeding and Genetics, Visva-Bharati University, Santiniketan, West Bengal

Email : burrirachel1998@gmail.com[1]; ayonroy.plantpathology@gmail.com[1]; pmbubkv2012@gmail.com[1], rup.biotech@gmail.com[2]

Abstract

Rice sheath blight, caused by the pathogen *Rhizoctonia solani* (*R. Solani*), is one of the most destructive diseases of rice worldwide, resulting in yield losses upto 50% (Uppala and Zhou 2018). In the present study, forty-eight local rice genotypes collected from University, State, and National germplasm repositories representing eastern India were evaluated for resistance to sheath blight. The genotypes were inoculated with two distinct *R. solani* isolates collected from Pundibari (isolate 1) and Alipurduar (isolate 2). Percent Disease severity was calculated periodically for every 15 days based on Relative Lesion Height from the base of the plant above soil line using the standard 0–9 disease rating scale (IRRI, 2014). Area under disease progress curve was also enumerated for each genotype to get better understanding of sheath blight resistance. Among the evaluated genotypes, nine genotypes (Bangaladeshi (Banga Bandhu Red), Naveen, Moirangphou Khonkngangbi, Padum Sali, Kati Sali, Aghani bora, Nefabi Julsi, Sita bhog, AC-35038 (Godhi Akhi)) showed moderate resistance to isolate 1. While seven (BR-11-Sub-1, Mulagabhoru, Jayamati, Jal kuwari, Kanaklata, Sial Sali, Manipur black rice) exhibited moderate resistance to isolate 2 and Four genotypes (Keteki joha, Kunchenyfoe, Kushal, Gajep Sali) showed moderate resistance to both Isolate 1 and Isolate 2. The identified moderately resistant genotypes can serve as valuable genetic resources for sheath blight resistance breeding programme.

Keywords: *Sheath Blight, R.solani, Relative Lesion Height, Percent Disease severity , Area Under Disease Progress Curve (AUDPC)*

Effect of Chitosan and Gibberellic Acid on Flowering of Ornithogalum (*Ornithogalum thyrsoides*) Under Terai Region of West Bengal

Chaithra P.
Department of Floriculture, Medicinal and Aromatic Plants, Faculty of Horticulture, Uttar Banga Krishi Viswavidyalaya
Corresponding author's email id: chaithrap123moodal@gmail.com

Abstract

Ornithogalum (*Ornithogalum thyrsoides* Jacq.), a geophytic ornamental belonging to the Asparagaceae family, is valued for its attractive white flowers and is widely used as a cut flower, potted plant, garden ornamental and also in landscaping. This frost-tolerant bulbous ornamental is well suited to hilly and temperate regions, while its cultivation in the plains remains difficult. Adapting Ornithogalum to subtropical Terai plains may expand its cultivation, but short winters and long rainy periods reduce flower quality and hinder bulb harvesting. Chitosan like bio-stimulants may help in improving adaptation. Introducing this high-value flowering crop can offer a profitable alternative by expanding opportunities beyond conventional cultivation. Reducing its vegetative phase through bio-stimulants and Plant growth regulators (PGRs) can help to overcome these limitations. Among PGRs, Gibberellic acid enhances growth, development and early flowering in ornamentals. However, studies on its combined use with chitosan in bulbous ornamentals, especially Ornithogalum are limited. The present study was conducted at the Instructional Farm, Department of Floriculture, Medicinal and Aromatic Plants, Uttar Banga Krishi Viswavidyalaya, West Bengal, India. The experimental design consists of 10 treatments including Chitosan (1.5% nano, high, medium and low molecular weight grades) and GA_3 (0 & 100 ppm levels). The results suggested that T_8 (Chitosan Medium Molecular Weight (1.5%) + Gibberellic acid @100ppm) represented as most promising among the treatments as it showed best in number of days required for opening of 1st floret (145.37±3.71), number of days required for opening of last flower (159.27±3.20), number of inflorescence per plant (4.7±0.59) and number of florets per inflorescence (20.03±4.41). However, T_6 (No Chitosan + Gibberellic acid @100ppm) showed best results in spike initiation (125.6±2.20) and number of days required for 1st floret maturity stage (140.67±4.01).

Keywords: *Ornithogalum thyrsoides, Asparagaceae, Chitosan, Bio-stimulant, Plant growth regulators, Gibberellic acid.*

Evaluation of microbial consortia for growth promotion and rhizome rot suppression in ginger

***Debnath D. and Debnath A.**
Department of Plant Pathology, Pundibari, Cooch BeharUttar Banga Krishi Viswavidyalaya
E-mail: drishtidebnath89@gmail.com

Abstract

India, widely recognized as the "Spice Bowl of the World" dominates global spice cultivation due to its diverse agro-climatic zones, producing over 75 different types of spices. Among these, ginger (*Zingiber officinale*) holds immense economic and therapeutic importance. However, the intensification of ginger

cultivation has led to severe disease pressures, most notably rhizome rot (*Pythium* species) and wilt (*Ralstonia solanacearum*). Management of rhizome rot and wilt complex is still very challenging for the farmers if conditions are found very favourable for the disease occurrence. Chemical management of rhizome rot is found to be successful to some extent, but due to the hazardous effects, biological control has emerged as a superior and sustainable alternative by utilising beneficial microorganisms like *Trichoderma* sp. and *Pseudomonas fluorescens*. In our study at Pundibari, we have used microbial consortia (*Trichoderma erinaceum* and *Pseudomonas fluorescens*) with and without fertilizers and fungicides for growth promotion as well as disease suppression. In the field experiment, it is observed that microbial consortia showed a very good effect on the germination, growth and yield of ginger in comparison to the absolute control. In case of disease suppression, our microbial consortia of *Trichoderma erinaceum* with *Pseudomonas fluorescens* showed a significant result.

Keyword: *Ginger, rhizome rot and wilt, microbial consortia, growth, Trichoderma erinaceum, Pseudomonas fluorescens*

Optimizing Berry Retention in 'Dogridge': A Key Grape Rootstock

Dhananjay N. Gawande*
Sr. Scientist (Plant Breeding) ICAR-National Research Centre for Grapes, Manjari Farm Post, Solapur Road,
Pune-412307, Maharashtra, India
Corresponding Author email ID: dngawande2016@gmail.com

Abstract

'Dogridge' is an important widely cultivated grape rootstock by Indian grape growers due to its abiotic stress tolerance and its positive response on berry size of scion varieties grafted on it. Dogridge is characterized by very small bunches, averaging 10–20 berries per bunch. It exhibit heavy berry drop right from berry set stage till its maturity. In Rootstock breeding when Dogridge is used as female this berry drop imposes restriction in obtaining hybrid population. To support the ongoing rootstock breeding activities at ICAR-NRCG, Pune; the experiment was planned during 2023-24 in Randomized Complete Block Design with five replications of each treatment for enhancing berry retention in Dogridge. Four treatments viz., applications of Indole-3-butyric acid (IBA) @20 ppm at fruit set (T2), spraying CaCl2 @0.75% at fruit set and repeated again after 15 days interval (T3); application of $CaNO_3$@0.8% at *veraison* stage (onset of berry maturity) (T4) including control (T1) were tried to restrict the unwanted berry drop. The analysis of variance revealed a highly significant effect of treatments on berry drop, with an F-value of 74.09 ($p < 0.001$), indicating significant differences among treatment means. The coefficient of variation (CV) was 14.38%, reflecting acceptable experimental precision. Berry drop ranged from 16.64% to 72.57% across treatments. Treatment-4 recorded the lowest berry drop (16.64%), making it the most effective treatment, whereas control showed the highest berry drop (72.57%). Treatments 2 and 3 resulted in berry drop values of 39.06% and 38.45%, respectively, and were statistically at par, as their difference was smaller than the critical difference (CD) 8.35. Overall, application of $CaNO_3$@0.8% (T-4) at *veraison* stage was found significantly superior in berry retention which reduced berry drop from 72.57% to 16.64%.

Keywords*: Grape, Dogridge, Berry-Drop, Rootstock Breeding, Veraison, Calcium Nitrate*

Screening of *Trichoderma* isolates based on decomposing capacity

Dipayan Hazra, Anamika Debnath, Ayon Roy, Prateek Madhav Bhattacharya
Department of Plant Pathology, Uttar Banga Krishi Viswavidyalaya,
Pundibari, Cooch Behar- 736165
Corresponding author's email: dipayanhazra78@gmail.com

Abstract

Crop residue burning is causing huge economic losses and environmental hazards. Microbial mediated ex situ composting could be a viable solution which would not only reduce the straw burning but also will enrich nutrition to the soil. Thus, there is a growing demand for the different microbial strains producing decomposing enzymes. In present study *Trichoderma* isolates screened for cellulase, xylanase and laccase activity. From these tests it was possible to select strains that presented the highest enzymatic indices (EI). Strain UBT 19 showed highest cellulase production where as UBT 28 showed highest xylanase production. Five strains of *Trichoderma* showed Laccase activity. UBT 28 & UBT 36 are two strains which found to produce all the three enzymes.

Keywords*: Trichoderma, Decomposition, Cellulase, Xylanase, Laccase*

Adventitious Root Induction and submerged Cultivation of *Rauvolfia serpentina* as a Sustainable Approach for Reserpine Production

Dr Karuna Dhiman*[1], Sheetal Thakur[1] and Dr Reena Kumari[1]
Department of Biotechnology, College of Horticulture and Forestry, Neri, Hamirpur (H.P.)
Corresponding author email id: dhimankaruna@gmail.com

Abstract

Rauwolfia serpentina L. is an endangered medicinal plant valued for its pharmaceutically important alkaloids. The present study aimed to establish an efficient adventitious root culture system and optimize culture conditions to enhance biomass and phytochemical production under *in vitro* conditions. Adventitious root culture was established using leaf explants. Leaf explants were collected from maintained healthy mother plants and treated with 5% Bavistin followed by 0.1% HgCl, , resulted in maximum explant survival (70%) and contamination-free cultures (80%). Adventitious root regeneration was successfully achieved using MS medium supplemented with different auxins, with the highest root induction frequency (93%) observed on MS medium containing 2.0 mg/L NAA and 1.0 mg/L IBA through pre callus stage. In addition, various parameter i.e. different medium strength, varying sucrose concentration, varying auxin (NAA and IBA) concentration and different inoculum density were also optimized under submerged cultivation. The maximum fresh root biomass (12.114) with a high relative growth rate (0.622±0.006) and growth index (0.917±0.005) was achieved in half strength MS media having 1% sucrose, and 1.0mg/L IBA seeded with 4% inoculum density. Phytochemical analysis revealed enhanced accumulation of phytoconstituents in induced adventitious roots as compared to mother plant roots. LC-MS analysis further also confirmed presence of reserpine in *in vitro* induced adventitious roots and good yield of reserpine content was recorded (225mg/100g) in adventitious roots which is slightly high then donor plant. Overall, the optimized adventitious root culture system provides a sustainable and efficient approach for biomass production and enhanced phytochemical synthesis in *Rauwolfia serpentina* L.

Keywords*: Adventitious root culture, Sarpagandha, Reserpine, Endangered, Phytochemicals*

Farmer Producer Organizations as Innovative Pathways to Sustainable Livelihoods and Socio-economic impacts among Smallholders.

***Firoj Aktar[1], Prof. P. K. Pal[2] and Dr. Darshan N.P[3]**

[1]Research Scholar, Dept. of Agricultural Extension, Visva-Bharati, Santiniketan, Bolpur, West Bengal.

[2]Head (Agril. Extension) and Director of Extension Education, Uttar Banga Krishi Vishwavidyalaya, Cooch Behar, West West Bengal.

[3]Assistant Professor, Dept. of Agricultural Extension, Visva-Bharati, Santiniketan, Bolpur, West Bengal.

Email: aktararg786@gmail.com

Abstract

Farmer Producer Organizations (FPOs) have emerged as an important institutional mechanism for improving the livelihoods of smallholder farmers by enhancing their access to inputs, credit, technology, and markets. The present study evaluates the role of FPOs in enhancing income, livelihood security, and socio-economic empowerment among smallholder farmers in Malda district of West Bengal. A comparative research design was adopted involving 90 respondents, comprising 45 FPO members and 45 non-members. Primary data were collected through a structured interview schedule and analyzed using statistical tools such as Z-test, correlation, regression, and factor analysis. The findings indicate that FPO membership positively influences employment opportunities, market access, farm management skills, and livelihood capital assets. FPO members reported substantially higher farm and household incomes, improved access to institutional credit, greater participation in decision-making, and enhanced social inclusion. The study concludes that FPOs serve as effective vehicles for sustainable livelihood enhancement and rural development, although strengthening governance, market linkages, and capacity-building initiatives remains essential for maximizing their impact and scalability.

Keywords: *Farmer Producer Organizations (FPOs), Smallholder Farmers, Livelihood Security, Socio-economic Empowerment, Income Enhancement.*

Identification of Heat-Resilient Bread Wheat Genotypes Through Integrated Field-Based Phenotyping

Sunishtha Mishra[1], Girish Chandra Pandey[1]*

[1]Dept. of Bioscience and Biotechnology, Banasthali Vidyapith, Rajasthan, India

****girishchandrapandey@banasthali.in***

Abstract

Terminal heat stress is a major constraint to wheat production, particularly in regions where elevated temperatures coincide with reproductive and grain-filling stages. The present study aimed to identify heat-resilient bread wheat (*Triticum aestivum* L.) genotypes through integrated field-based phenotyping under contrasting sowing environments. Ten wheat genotypes were evaluated during two consecutive crop seasons (2023–24 and 2024–25) under timely-sown and late-sown conditions at Banasthali Vidyapith, Rajasthan. Late sowing was used to impose terminal heat stress, exposing plants to maximum

temperatures of 40–44°C during anthesis and grain filling. Phenological, physiological, agronomic, and yield-related traits were assessed to characterize genotypic responses to heat stress. Phenological traits such as days to heading, anthesis, and physiological maturity exhibited relatively minor changes under stress conditions. In contrast, grain-filling duration, plant vigour, physiological efficiency, and yield-associated traits showed marked genotypic differences. Heat-resilient genotypes maintained longer grain-filling duration and superior performance under late-sown conditions, indicating enhanced capacity to sustain growth and assimilate partitioning during high-temperature stress. Integrated evaluation consistently identified HP1209, DBW316, HD3090, PBW590, and JKW261 as resilient genotypes, whereas PBW660 and HI1544 exhibited greater susceptibility to terminal heat stress. The findings demonstrate the effectiveness of integrated field-based phenotyping for identifying heat-resilient wheat genotypes and key adaptive traits associated with stress tolerance. These genotypes represent valuable genetic resources for breeding programmes aimed at developing climate-resilient wheat cultivars capable of maintaining productivity under increasingly warmer environments.

Keywords: *bread wheat, terminal heat stress, field phenotyping, heat resilience, grain filling, yield stability, climate resilience.*

Soil Carbon Distribution and Stock Dynamics across Land Use Systems and Elevational Gradients in the Eastern Himalayan Region

Hriday Kamal Tarafder* and Amrit Tamang

*Regional Research Station, Hill Zone, Uttar Banga Krishi Viswavidyalaya, Kalimpong, India

[1]Uttar Banga Krishi Viswavidyalaya, Pundibari, Coochbehar, India

****Corresponding author: Tel: +91 8697335105***

E-mail address: hridaykamalt25@gmail.com

Abstract

Soil carbon dynamics are critical indicators of ecosystem functioning and carbon sequestration potential, particularly in fragile Himalayan agroecosystems. This study investigated the effects of land use systems, altitudinal gradients, and soil depth on total organic carbon (TOC), total inorganic carbon (TIC), total carbon (TC), and carbon stocks in the North-Eastern Himalayan region of West Bengal. Six land use systems; open crop fields, mandarin orchards, large cardamom agroforestry, ginger-based agroforestry, tea plantations, and undisturbed forests were evaluated across four altitudinal gradients (400–500 m, 900–1000 m, 1400–1500 m, and 1900–2000 m). The results revealed significant ($P < 0.05$) variations in soil carbon fractions among land use systems, altitudes, and soil depths. Undisturbed forests recorded the highest TOC (29.61 g kg{ ¹), TC (29.87 g kg{ ¹), and TOC stock (148.80 Mg ha{ ¹), whereas open crop fields showed the lowest values (14.96 g kg{ ¹, 15.29 g kg{ ¹, and 84.74 Mg ha{ ¹, respectively). In contrast, TIC was highest in open crop fields (0.32 g kg{ ¹) and lowest in forests (0.26 g kg{ ¹). Soil TOC and TC increased significantly with altitude, reaching maximum values at 1900–2000 m, while TIC decreased with increasing elevation. Across all land use systems, TOC and TC declined with soil depth, whereas TIC increased with depth. Carbon stock followed trends similar to TOC, indicating that organic carbon constituted the major portion of total soil carbon. The findings demonstrate that undisturbed forests, tea plantations, and large cardamom agroforestry systems possess greater carbon sequestration potential than conventional open cropping systems. Therefore, adoption of perennial and agroforestry-based land use systems can enhance soil carbon storage and contribute to climate change

mitigation in Himalayan ecosystems.

Keywords: *Land use change, Altitudinal variation, Total organic carbon, Total inorganic carbon, carbon stock, Eastern Himalayan region*

Preliminary screening of Aluminium Toxicity Tolerance of selected Rice (*Oryza sativa* L.) Landraces of North-East India

Jayita Debnath*[1], Jayanwita Sarkar[2], Jyotsna Das[3]

[1]Department of Botany, Cooch Behar Panchanan Barma University, Cooch Behar, West Bengal, India
[2]Department of Botany, Cooch Behar Panchanan Barma University, Cooch Behar, West Bengal, India
[3]Department of Botany, Alipurduar University, Alipurduar, West Bengal, India
Corresponding author e-mail: jayita.botany@gmail.com

Abstract

Aluminium (Al) is the third most abundant metal in earth crust, whose chemical form is mainly dependent on soil pH. The most toxic form of Al with respect to plants is Al^{3+}, which exists in soil pH in and around less than 5. Acidic soil significantly limits crop production mainly due to Al^{3+} toxicity, impacting approximately 50% of the world's arable land. In India, acid soils are found in the Himalayan region, Eastern and North-eastern plains, peninsular India, and coastal plains under different agro climatic situations. Al^{3+} toxicity in plants causes root growth inhibition leading to less nutrient and water uptake impacting crop productivity as a whole. Plant species or varieties greatly differ in their resistance to Al stress which is controlled genetically and selection is possible for better Al-toxicity tolerance in different crops including cereals. North East (NE) India has a vast diversity of rice landraces and some of them have believed to develop Al toxicity tolerance due to their chronic exposure to soil acidity. The present study aimed at to explore the Al toxicity stress tolerance of 6 selected rice landraces of different parts of NE India under hydroponics condition. The rice landraces were grown under different aluminium concentrations in hydroponic culture with a view to evaluate the differential response to Aluminium stress. Parameters such as root length, shoot length, Root Tolerance Index (RTI), Root Relative Reduction (RRR), Root Relative Water Content (RRWC) were measured for Al toxicity tolerance. Histochemical staining like Hematoxylin staining was done to determine the accumulation of aluminium in root region of rice landraces. The result showed that a spectrum of tolerance among the selected rice landraces.

Keywords: *Acid soil, Aluminium toxicity, Root tolerance index, rice*

Impact of Reference Gene Choice on Accurate Gene Expression Analysis under Emerging Contaminant Exposure

Kavita Kumari[1]*, Md. Aftabuddin[1], Subir Kumar Nag[1], Soma Das Sarkar[1], Shubhadeep Ghosh[2], Basanta Kumar Das[1]

[1]ICAR-Central Inland Fisheries Research Institute, Barrackpore, India.
[2]Indian Council of Agricultural Research, New Delhi, India
Correspondence: Kavita Kumari: kavitacof@gmail.com

Abstract

Accurate quantification of gene expression in organisms exposed to emerging contaminants (ECs) requires the use of stable reference genes for reliable normalization in quantitative real-time PCR (qRT-

PCR) analyses. Inappropriate reference gene selection can significantly affect the interpretation of transcriptional responses and compromise the accuracy of gene expression studies. In the present investigation, the expression stability of six candidate housekeeping genes (EEF1A1, GAPDH, ACTB, TBP, RAG1, and PKM) was systematically evaluated in the liver of the Indian major carp, Labeo catla, following exposure to three environmentally relevant contaminants, namely chlorpyrifos, triclosan, and oxytetracycline. Gene stability was assessed using four widely accepted statistical algorithms, including geNorm, NormFinder, BestKeeper, and the comparative ÄCt method, and an overall ranking was generated using RefFinder by integrating the outputs of these approaches. The analyses consistently identified EEF1A1 as the most stable reference gene across all treatment groups, whereas PKM and RAG1 exhibited comparatively lower stability. To assess the influence of reference gene selection on target gene quantification, the expression of CYP1A1, a key biomarker of xenobiotic metabolism and contaminant exposure, was normalized using both stable and unstable reference genes. The results revealed notable differences in CYP1A1 expression patterns depending on the normalization strategy employed, highlighting the potential impact of unsuitable reference genes on data interpretation. These findings emphasize the importance of validating candidate reference genes under specific experimental conditions before their application in qRT-PCR studies. The study provides a reliable basis for selecting appropriate normalization controls in ecotoxicological assessments and contributes to improving the accuracy, reproducibility, and biological relevance of gene expression analyses in fish exposed to emerging environmental contaminants.

Keywords: *aquatic toxicology, housekeeping genes, chlorpyrifos, oxytetracycline, triclosan*

The effect of vine cutting size and growing media on quality planting material preparation of Sweet potato (*Ipomoea batatas* (L.) Lam.)

Lipika Nath*, Subhamoy Sikder, Subom Rai and M. Velavan

Department of Vegetable and Spice crops, Uttar Banga Krishi Vishwavidyalaya, Pundibari, Cooch Behar, West Bengal, India, 736165.

****Corresponding author e-mail: lipika.nath@aau.ac.in***

Abstract

Sweet potato is an important root crop widely used for both food and feed purposes. A research trial was conducted during the 2024–2025 cropping seasons at the experimental farm of the Department of Vegetable and Spice Crops, UBKV, Pundibari, Cooch Behar, West Bengal, to evaluate the effect of vine cutting size and growing media on seedling growth and yield of sweet potato. The experiment was laid out in three-factor Randomized Complete Block Design (3 × 3 × 4) with three replications. Three varieties, namely Bhu Sona, Sree Kanaka, and Gouri, were considered as Factor A, vine cuttings of three different lengths (15 cm, 30 cm, and 45 cm) as Factor B. These cuttings were planted in polybags using four different growing media combinations as Factor C: G• (topsoil + sand + FYM in 1:1:1 ratio), G, (cocopeat + sand + vermicompost in 1:1:1 ratio), G*f* (cocopeat + sand + poultry manure in 1:1:1 ratio), and G,, (cocopeat + sand + vermicompost + poultry manure in 1:1:1:1 ratio). The study aimed to identify the most suitable combination for enhancing seedling growth and yield. Among the treatments, the combination V*f* C, G,, (Gouri with 30 cm vine cuttings grown in G,, medium) was found superior in most of the growth and yield parameters such as, the maximum vine length (221.56 cm), number of primary branches (4.93), leaf area (93.47 cm^2), number of marketable tubers per plant

(3.43), total marketable yield per hectare (26.03 t/ha).

Keywords*: Sweet potato, variety, vine cutting size, growing media, seedling growth, yield performance*

Varietal Performance of Phalaenopsis Orchids under Terai Conditions

Malati Murmu[1]* & Arpita Mandal Khan[1]

[1]Department of Floriculture, Medicinal and Aromatic Plants, Faculty of Horticulture, Uttar Banga Krishi Viswavidyalaya, Cooch Behar, West Bengal-736165

Corresponding author e-mail: murmu.malati18@gmail.com

Abstract

Phalaenopsis orchids, commonly called moth orchids, hold the leading position in the global market as potted flowering plants. In India, it is naturally distributed in Assam, the Eastern Himalayas, and the Andaman Islands. Phalaenopsis orchids grow best between 26 °C and 29 °C combined with 60-80% relative humidity. Terai and Dooars region of West Bengal offers a congenial climate for commercial cultivation of this crop. The objective of the study is to assess the performance of Phalaenopsis under Terai agro-climatic zone, wherein 10 multiflora type cultivars, Sweetheart, Friday Flirt, Grazia, Fancy Freckles, Carrot Cake, Summer Light, Prima Piano, Red Eye, Papagayo and Spring Moods were evaluated under 75% shade net house using completely randomized design. The study was done during 2023 to 2025 in Uttar Banga Krishi Viswavidyalaya, Coochbehar. Vegetative characters like plant height, leaf length, leaf width; along with flower morphological characters were observed. The observations indicated significant variations in vegetative parameters of the 10 cultivars. The cultivar Prima Piano plants were the most vigorous whereas Carrot Cake plants were small. Significant difference was also observed in flower morphological characters *viz.* number of inflorescences/plants, rachis length, flower length and width, length and width of dorsal and lateral sepal and petals. Maximum size of flower (8.57cm length and 8.7cm width) is found in Carrot Cake, though the plants were smaller, followed by Summer Light, Red Eye and Fancy Freckles. Sweet Heart flowers were small measuring 3.9 cm length and 4.67 cm width but, bore maximum numbers of flowers per inflorescence (23) followed by Fancy Freckles (17) and Friday Flirt (10). The results of the study will be helpful in selecting the multiflora Phalaenopsis varieties for specific horticultural purposes like small table top plant or floral arrangement, landscaping, indoor decoration etc.

Keyword: *Phalaenopsis, orchid, varietal evaluation.*

Sericulture as a Catalyst for Sustainable Development: Integrating Economic Resilience, Ecological Stewardship, and Social Equity

Masuma Rahaman[1]* & Md. Hasrat Ali[1]

[1]Department of Agricultural Economics, Bidhan Chadra Krishi Viswavidyalaya Mohanpur 741252 Nadia, West Bengal, India

Corresponding author email: masumarahaman.cob@gmail.com

Abstract

Sericulture, the ancient practice of cultivation of silkworms for silk production, is becoming increasingly recognized as a multidimensional tool for sustainable rural development in the contemporary world. Sericulture consists of the ecological productivity of the mulberry plant (*Morus alba*), laboriousness of

cultivating silkworms (*Bombyx mori*) and the craftsmanship required in spinning and weaving silk products out of silk yarn. It generates value along environmental, social and economic lines simultaneously. The United Nations 2030 Agenda for Sustainable Development has established seventeen Sustainable Development Goals (SDGs). Sericulture is considered as an ideal example of an eco-friendly agro-based industry which would support sustainable principles. This research paper evaluates the importance of sericulture towards achieving the UN 2030 Agenda for Sustainable Development. Research shows that sericulture is directly or indirectly linked to at least nine out of the seventeen goals established by the UN as SDGs, highlighting its multidimensional contribution to sustainable development. The most significant SDGs impacted by sericulture include No Poverty (SDG 1), Gender Equality (SDG 5), Decent Work and Economic Growth (SDG 8), and Climate Action (SDG 13). In the year 2024–25, the sericulture industry in India generated employment for approximately 9.8 million people (CSB 2025). It clearly depicts that the sector plays an important role in enhancing the standard of living of rural households and poverty reduction by offering year-round employment and supplementary income opportunities to small and marginal farmers. Mulberry plantation plays an important role in carbon sequestration, prevention of soil erosion, and ecological stability. Silk, the end product of sericulture, is also an eco-friendly and biodegradable natural fiber. Higher engagement of women and low capital requirement make sericulture more of a social inclusion industry as well. In addition to this, the concept of circular economy is reflected through the use of the by-products of sericulture, such as sericin protein, silkworm pupae, and mulberry fruit. Sericulture provides an efficient means through which various SDGs can be realized at once and thereby illustrating that a rural sector industry is capable of contributing towards sustainable development.

Keywords: *Sericulture, Sustainable Development Goals, Rural livelihood, Gender Equality, Ecological Stability, Circular Economy*

Assessment of Prescription-based Nutrient Management as a Climate-Resilient Approach to Soil Sustainability in an Acid Alfisols

Mercy Chinneihoi Haokip[1]*, S. P. Dixit[2], Naveen Datt[2], Kallol Bhattacharyya[1]

[1]Department of Agricultural Chemistry and Soil Science, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, West Bengal-741252, India

[2]Department of Soil Science, Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya, Palampur, Himachal Pradesh-176062, India

Corresponding author's e-mail: haokipchinneihoi98@gmail.com

Abstract

Climate change and intensive cultivation have accelerated nutrient depletion and soil degradation, particularly in acid Alfisols, threatening sustainable crop production. Site-specific, prescription-based nutrient management offers a promising climate-resilient approach to maintain soil health and sustain crop productivity. A long-term field experiment initiated in 2007 under a maize–wheat cropping system was undertaken to evaluate the effectiveness of Soil Test Crop Response (STCR)-based fertilizer prescription, with and without farmyard manure (FYM), in regulating soil micronutrient dynamics and sustaining productivity in an acid Alfisol. The field experiment was laid out in a randomized block design (RBD) with 8 treatments viz., Control, FP, GRD, STB, CF-STCR30, FYM-STCR30, CF-STCR40 and FYM-STCR40. After fourteen years of continuous cropping, the unfertilized control exhibited a

marked decline in DTPA-extractable Fe, Zn, Cu, and Mn compared with the initial soil status, indicating nutrient depletion over the years. In contrast, STCR-based FYM treatments maintained significantly greater micronutrient availability than conventional practices. The highest DTPA-extractable Fe (33.4 mg kg{ ¹), Mn (27.3 mg kg{ ¹), Zn (1.50 mg kg{ ¹), and Cu (0.88 mg kg{ ¹) contents were recorded under FYM-STCR40 treatment. Enhanced micronutrient availability was reflected in greater nutrients uptake and sustained crop productivity, depicting the highest grain yield of 43.6 q ha-1 in FYM-STCR40 with a percentage deviation of 3.6 per cent. The findings underscore that STCR-based FYM can effectively sustain micronutrient availability and support long-term productivity in acid Alfisols. Therefore, prescription-based nutrient management ensures a promising climate-resilient soil management strategy for maintaining soil health and ensuring sustainable crop production under intensive maize–wheat systems.

Keywords: *Climate change, Soil health, Sustainability, STCR approach, Yield*

Assessing the role of livestock farming on livelihood enhancement: A case study of West Garo Hills District of Meghalaya

Mikkimchi G Momin[1] and Durga Charan Kalita[*]

[1]Ph.D. Scholar, Department of Rural Development and Agricultural Production, North Eastern Hills University, Tura Campus-794002

[*]Professor, Department of Rural Development and Agricultural Production, North Eastern Hills University, Tura Campus-794002

Corresponding author e-mail: himalidurga@gmail.com

Abstract

The present study was conducted to assess the role of livestock farming in enhancing the livelihood of rural households in West Garo Hills District of Meghalaya. The livestock farming is an important livelihood opportunity for the people of Garo Hills. The Garo people practice agriculture along with livestock farming in every household, which helps to alleviate the poverty by increasing source of income and ensuring food security and nutritional balance in rural areas. However, the study aimed to examined whether livestock farming alone can provide sufficient income to enhance rural livelihoods. The study was conducted in three randomly selected blocks of West Garo Hills, namely Rongram, Gambegre, and Dalu. Total 240 numbers of respondents were taken and their socio-economic characteristics were studied. Data were collected through interview method. The respondents are interviewed with predesigned and pretested interview schedule to assess the socio-economic status, impact, utilization and constraint faced by livestock farmers. Findings revealed that 55 per cent of the respondents were illiterate, while 24 per cent had primary education, 13 per cent had middle school education, 5 per cent had matriculation, and 3 per cent had higher secondary education. Agriculture was the main occupation of the respondents, followed by wage earning, government service, and business. Among the livestock farming, piggery contributed the highest share of income (57%), followed by cattle rearing (24%), poultry farming (14%), and goat rearing (5%) in the selected areas. The economics of livestock farming was analysed using different cost concepts and profitability measures. Major factors affecting profitability of livestock farming were disease outbreaks (47%), high feed costs (23%), lack of veterinary support (18%), and market fluctuations (10%). The impact of livestock farming on livelihood enhancement was assessed using income and employment indicators. Statistical tools such as the t-test

and multiple regression analysis were used to evaluate the impact of livestock farming on livelihood improvement. Hence, it can be concluded that livestock farming plays a vital role in livelihood enhancement among rural households in West Garo Hills.

Keywords: *Livestock Farming, Food security, Nutritional balance, Livelihood enhancement, profitability and economics of livestock Farming.*

Impact of planting geometry on sugarcane growth

Moeen Ahmad[1], Mahindra Pratap Singh[2] and Virendra Kumar Singh[3]

[1]Research Scholar, School of Agriculture, IFTM University, Moradabad, Uttar Pradesh, 244102
[2]Assistant Professor, School of Agriculture, IFTM University, Moradabad, Uttar Pradesh, 244102
[3]Professor, School of Agriculture, IFTM University, Moradabad, Uttar Pradesh, 244102
Corresponding author- mahendraarya7@gmail.com

Abstract

The present investigation entitled ***"Effect of planting geometry on sugarcane performance in late planted sugarcane"*** was carried out during the spring season 2025–26 at IFTM University, Moradabad, Uttar Pradesh. The experiment was laid out in a Randomized Block Design (RBD) with eleven treatment combinations and three replications. Treatments consisted of different planting geometries: 90 × 30 cm, 90 × 45 cm, 120 × 30 cm, 120 × 45 cm, 120 × 60 cm, 150 × 30 cm, 150 × 45 cm, 150 × 60 cm, 150 × 30 cm (paired row 40:110), 150 × 40 cm (paired row 30:120), and farmer's practice as control. Sugarcane variety Co 0118 was used, raised from single-bud settlings in polybags and transplanted after 35 days. The results revealed that planting geometry exerted a significant influence on plant growth, tiller population, yield attributes, cane yield, and sugar yield. Among the treatments, paired-row planting at 150 cm × 30 cm (40:110 cm) recorded the highest tiller population from 30 DAP (70.7×10^3 ha^{-1}) to 180 DAP (129.0×10^3 ha^{-1}), along with superior plant height, cane yield (128.9 t ha^{-1}), and sugar yield (19.14 t ha^{-1}). In contrast, the conventional narrow spacing of 90 cm × 30 cm resulted in comparatively lower growth and productivity. Juice quality parameters, including Brix, Pol, Purity, and Commercial Cane Sugar (CCS%), were not significantly affected by the different planting geometries. The findings of the study indicate that paired-row planting geometry, particularly 150 cm × 30 cm (40:110 cm), is an efficient and sustainable planting arrangement for enhancing cane yield and sugar productivity in late-planted sugarcane without adversely affecting juice quality. Therefore, adoption of this planting geometry may be recommended to sugarcane growers for improving productivity and profitability under late-planted conditions.

Keywords: *Sugarcane, planting geometry, paired row, cane yield, sugar yield, late planting*

Integrated Electrochemical and Chemometric Platform for Accurate $As^{3}z$ Monitoring

Monika Antil[1,2]

[1]The Academy of Scientific and Innovative Research, Ghaziabad, Uttar Pradesh 201002, India
[2]CSIR-Central Scientific Instrument Organisation, Chandigarh 160030; India
Author Email ID: monuantil09@gmail.com; 0000-0003-0351-988X

Abstract

Arsenic contamination in portable water continues to pose a serious global public health concern, creating an urgent need for cost-effective, reliable, and field-deployable detection technologies. The reported electrochemical arsenic approach relies on nanomaterial-modified electrodes and complex fabrication procedures, which often increase cost, reduce reproducibility, and hinder large-scale implementation. In this study, we explored a simple yet highly effective sensing strategy using a commercially available unmodified gold electrode with Square Wave Voltammetry (SWV). The developed platform exhibited high sensitivity (33.52 ¼A ¼M{ ¹), an ultralow detection limit of 0.017 ¼M (~1.34 ppb), well below the World Health Organisation (WHO) guideline value of 10 ¼g L{ ¹, and excellent linearity ($R^2 > 0.99$) over a wide concentration range. The analytical performance within the linear range (0.1–1.0 ¼M) was further validated using chemometric analysis with the Unscrambler software, yielding a low root mean square error of calibration (RMSEC) of 0.01, confirming the robustness and predictive accuracy of the model. The sensor demonstrated excellent selectivity in the presence of high concentrations of potentially interfering ions and maintained reliable performance during the analysis of real tap water samples. Furthermore, a custom-developed portable electrochemical hardware platform yielded results comparable to those from a conventional laboratory electrochemical workstation, highlighting its suitability for on-site monitoring applications. The combination of an unmodified sensing surface, chemometrically validated quantification, and portable instrumentation offers a scalable, reproducible, and economically viable solution for arsenic monitoring, representing a significant step toward practical water-quality surveillance and improved public health protection.

Keywords: *As3+; Square-Wave Voltammetry; Electrochemical Sensing; Chemometric analysis; Environment Sustainability*

Identification and Characterization of a Candidate Gene Associated with Aluminium Stress Tolerance in Maize

Mritrisha Bhattacharjee[1*], Nirmal Mandal[1]

[1]Department of Agricultural Biotechnology, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal, India

[*]***Corresponding author email: mitrishabhattacharjee@gmail.com***

Abstract

Aluminium (Al) toxicity is a major constraint limiting maize productivity in acidic soils. The present study aimed to identify and characterize candidate genes associated with aluminium tolerance in maize using comparative transcriptome analysis of two contrasting genotypes, AVT-30011 (tolerant) and AVT-30008 (susceptible). RNA sequencing revealed significant differential gene expression under aluminium stress, among which ZmAT6 was identified as a promising candidate due to its high level of induction in the tolerant genotype. Quantitative real-time PCR analysis confirmed a strong dose-dependent induction of ZmAT6, with transcript abundance increasing up to 160-fold under higher aluminium concentrations in the tolerant genotype. Functional characterization through KEGG pathway and protein–protein interaction (PPI) analyses suggested that ZmAT6 may enhance aluminium tolerance by regulating proline biosynthesis, antioxidant defense mechanisms, and ROS detoxification. The findings highlight the potential role of ZmAT6 in aluminium stress tolerance and suggest its utility as a candidate gene for developing maize cultivars adapted to acidic soil environments.

Keywords*: Aluminium toxicity, Maize, RNA sequencing, ZmAT6, ROS-detoxification, Protein-protein interaction (PPI)*

Amino Acid Composition and Micronutrient Abundance Highlight the Nutritional Superiority of Gandhakasala and Njavara Indigenous Rice Varieties

Nabaneeta Basak[1*], Gaurav Kumar[1], P. Sanghamitra[2], Sutapa Sarkar[2], Kingshuk Dhali[3]

[1]Crop Physiology and Biochemistry Division, ICAR-Central Rice Research Institute, Cuttack-753006, Odisha

[2]Crop Improvement Division, ICAR-Central Rice Research Institute, Cuttack-753006, Odisha

[3]Department of Post Harvest Engineering, Faculty of Agricultural Engineering, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, West Bengal-741252

****Corresponding author e-mail: bsk.nabaneeta@gmail.com***

Abstract

Rice serves as the primary staple food for more than half of the global population and constitutes a major source of dietary energy in developing countries. Despite its importance, deficiencies of essential micronutrients, particularly iron (Fe) and zinc (Zn), remain widespread public health concerns. Indigenous rice germplasm represents a rich reservoir of genetic diversity and may harbor superior nutritional attributes that can be exploited for crop improvement and biofortification. The present study aimed to evaluate the nutritional quality of selected indigenous rice varieties from southern India and identify nutritionally superior genotypes for breeding programmes. A total of 25 indigenous rice varieties were assessed for protein content, total amino acid abundance, grain iron concentration, and zinc concentration. Significant variation (P d• 0.05) was observed among the genotypes for all nutritional traits, indicating substantial genetic diversity. Protein content ranged from 7.45% to 12.85%. Gandhakasala exhibited the highest protein content (12.85%), followed by Triveni (12.49%) and Remya (12.12%), suggesting their potential as valuable sources of dietary protein. Grain iron concentration varied from 5.85 to 18.19 ppm, with Chennellu (18.19 ppm) and Matta Triveni (17.46 ppm) recording the highest levels, while Gandhakasala also showed elevated iron content (14.94 ppm). Zinc concentration ranged from 10.97 to 31.22 ppm, with Uma (31.22 ppm), Kanchana (28.70 ppm), Marathondi (28.40 ppm), Asha (26.75 ppm), and Njavara (26.20 ppm) exhibiting superior zinc accumulation. Integrated evaluation of nutritional traits identified Gandhakasala and Njavara as the most promising genotypes. Gandhakasala combined high protein content with elevated iron concentration, whereas Njavara possessed appreciable protein content along with comparatively high iron and zinc levels. These findings highlight the potential of indigenous rice varieties as valuable genetic resources for the development of nutrient-dense cultivars. The identified genotypes can serve as donor parents in biofortification programmes aimed at alleviating protein-energy malnutrition and micronutrient deficiencies, thereby contributing to sustainable food and nutritional security.

Keywords: *Indigenous rice, nutritional quality, amino acids, iron, zinc, biofortification,*

Etiolation as a Strategic Tool and its Implications for Plant propagation and Micropropagation: A Review

Nasrina Naurin*[1], Sumita Pradhan[2]
[1]PhD Scholar [2]Assistant Professor
Department of Floriculture, Medicinal and Aromatic Plants, Uttar Banga Krishi Viswavidyalaya, Pundibari Coochbehar-736165
Corresponding author Email id- nasrinanaurin@gmail.com

Abstract

Etiolation, the growth of plant tissues under low or complete absence of light, has gained considerable attention as a pre-treatment strategy in plant tissue culture and micropropagation. This review summarizes research from a variety of plant systems, including decorative orchids like Cymbidium, Cattleya, and Paphiopedilum, herbaceous crops like *Cucurbita moschata*, and woody species like *Castanea sativa*. Etiolation produces softer, more malleable tissues that are extremely responsive to in vitro circumstances by mechanistically reducing lignification and promoting cell elongation. Additionally, it increases sensitivity to auxins and cytokinins, which modifies endogenous hormonal balance and promotes organogenesis. A favorable environment for morphogenesis is also produced by decreased phenolic compound buildup and altered gene expression in dark environments. Despite these benefits, etiolation's efficacy varies by species and is dependent on how well it integrates with ideal plant growth regulator regimes and subsequent light exposure for the development of chlorophyll and plant maturation. Its context-dependent role is shown by the fact that efficient regeneration can be accomplished in some systems without etiolation. This study emphasizes the physiological underpinnings, real-world uses, and constraints of etiolation, highlighting its contribution to the advancement of plant biotechnology and large-scale propagation techniques and the enhancement of micropropagation techniques by comprehending its underlying mechanisms and maximizing its application.

Keywords: *Etiolation, Plant propagation, Micropropagation, Organogenesis, Plant growth regulators, Phenolic compounds,*

Assessment of Genetic Variability in Trypsin Inhibitor and Lipoxygenase Activities among Soybean Genotypes and Identification of Genotypes with Low levels of Anti-Nutritional Factors

P.S.Raja[1*], B.R.Singh[1]
[1]Department of Molecular Biology and Genetic Engineering, Govind Ballabh Pant University of Agriculture and Technology, Pant Nagar 263145, Uttarakhand, India
Corresponding author e-mail: 58428@gbpuat.ac.in

Abstract

Soybean (*Glycine max* L.) is an agriculturally and economically important leguminous crop as a rich source of dietary protein and essential oils. But, its nutritional properties are limited by the accompanied anti-nutritional agents such as trypsin inhibitors (TI) and lipoxygenases (Lox) which make the food or feed unpalatable or undesirable. TI inhibit trypsin competitively, leading to food in-palatability. lipoxygenases catalyse the lipid-proxidation, leading to undesirable beany flavour. In the present study, 97 varieties of Soybean from the advanced breeding lines were analysed for the presence and quantification of these anti-nutritional factors. Trypsin inhibitors were estimated using trypsin

spectrometric assay and LOX activity was quantified spectrophotometric ally based on substrate oxidation reactions. The results revealed broad variability among genotypes for both traits, indicating a broad genetic base. KTI values varied from extremely low levels (~0.15) to very high activity exceeding 8.0 units, suggesting substantial allelic diversity. While, LOX activity ranged from 0.12 to 2.14, revealing moderate to high biochemical diversity across the evaluated genotypes. Wild germplasm, such as *Glycine soja* , exhibited high TI activity, while many of the advanced breeding lines showed low activity, suggesting the advancement in breeding programs. A comparative analysis between both the traits identified multiple superior genotypes characterised by low TI and low Lox activity. Promising lines such as DS1589, PS24, PK 262, PS 1732, and PS 1583 were found to be potential candidates for quality breeding programs. Correlation analysis suggested a weak relationship between TI and LOX activities, implying that these traits are likely inherited independently, facilitating the efficient selection and pyramiding of desirable alleles without significant genetic constraint. Hence, the study found substantial diversity between the varieties thus screening superior genotypes. These findings provide valuable insights in breeding programs to mitigate the anti-nutritional factors and enhancing seed quality for food and feed requirements.

Keywords: *trypsin inhibitor, lipoxygenase, soyabean, anti-nutritional factors, genotype screening, beany flavour*

Morphological Trait-Assisted Prediction of Lipoxygenase Activity in Soybean (Glycine max) Using Principal Component Regression

P.S.Raja[1*], B.R.Singh[1]

[1]Department of Molecular Biology and Genetic Engineering, Govind Ballabh Pant University of Agriculture and Technology, Pant Nagar 263145, Uttarakhand, India

****Corresponding author e-mail: 58428@gbpuat.ac.in***

Abstract

Soybean (*Glycine max*) is an incredible source of essential oils and rich protein composition. Grown omnipresent worldwide as a staple for the majority, its nutritional advantages are limited by the co-occurrence of associated anti-nutritional factors like Trypsin inhibitors and Lipoxygenases. Lipoxygenases are a group of iron containing non-heme isozymes that are responsible for aversive beany-flavour, which makes it less suitable for consumption. The amount of these Lipoxygenases varies between the varieties of soybean. Therefore it is necessary to screen the varieties with minimal Lipoxygenases, for them to be readily edible. In this study, we have screened 39 varieties of the soybean advanced breeding lines, for the Lipoxygenase activity using Lox spectrophotometric assay. We also monitored 10 morphological characters, which were used as feature variables for predictive modelling. Dimensionality reduction of the features was conducted using Principal Component Analysis (PCA) and Four Principal components were captured that accounted for 74.3% of the total variation. Multiple Linear Regression (MLR) was conducted on the components with the Lipoxygenase activity as the response variable for training the model, using K-fold cross validation, with optimal K value simulated and found to be 9 partitions, with minimum average RMSE of 0.82. The data split ratio between training and testing components was found best at 50%. Regression analysis identified phenological and architectural components as significant predictors of Lipoxygenase content. The model demonstrated fair predictive performance (R^2 H" 0.68), indicating that morphological traits can serve as dependable

indirect predictors of biochemical composition.

This study provides a robust template for screening soybean genotypes and highlights the potential of integrating biochemical assays with statistical modelling approaches for the soybean improvement. This study also investigates the potential to implement morphological traits in empirically predicting the Lipoxygenase activity in specific genotypes, and hence screening the varieties nutrient potential.

Keywords: *lipoxygenase, soyabean, anti-nutritional factors, Principal component analysis, multiple linear regression, big data analytics*

Performance of Dual-Purpose Maize Under Varied Crop Geometry and Nitrogen Management Under *Terai* Region

Pallab Sarkar[1]*, S. Vijay Kumar[1], Parthendu Poddar[1], Biplab Mitra[1], Wasim Reza[2], Bhaskar Ghosh[1],

[1]Department of Agronomy, Uttar Banga Krishi Viswavidyalaya, West Bengal

[2]Department of Agril. Entomology, Uttar Banga Krishi Viswavidyalaya, West Bengal

Corresponding author: pallabsarkar2014@gmail.com

Abstract

Maize (Zea mays L.), often referred to as the "Queen of Cereals," is an important cereal crop with diverse food, feed, and industrial uses. Despite possessing the world's largest livestock population (535 million heads), India faces a substantial fodder deficit owing to limited fodder area (4.4% of cultivated land). Therefore, a field experiment was conducted during 2021–2023 at Uttar Banga Krishi Viswavidyalaya, Pundibari, West Bengal (maize productivity: ~7.0 t ha{ ¹), to evaluate dual-purpose maize (DHM 117) under different crop geometries and nitrogen management practices. The experiment was laid out in a split-plot design with four replications. Main-plot treatments comprised three crop geometries: M• (30 cm × 10 cm, DHM 117 alternated with fodder maize cv. African Tall harvested at 60 DAS), M, (60 cm × 10 cm, DHM 117 as a dual-purpose crop), and M*f* (30 cm × 10 cm, African Tall with middle-row harvest at 65 DAS) along with 4 sub-plot treatments based on nitrogen levels (NPK ratio – 140:80:100 kg ha^{-1}) and cutting management viz. S1- no additional dose of N fertilizer, S2- additional dose 40 kg N ha^{-1} at 50 DAS, S3- additional dose 40 kg N ha^{-1} at 50 DAS and topping at grain hardening stage as green fodder. The total number of treatment combinations was 48. The treatment combination of crop geometry of 30 cm × 10 cm with application of an additional dose of 40 kg N ha{ ¹ at 50 DAS recorded the highest growth parameters, followed by crop geometry of 60 cm × 10 cm with the same nitrogen application. The highest fodder yield (240 q ha{ ¹) was recorded under crop geometry of 30 cm × 10 cm, where the middle row was harvested at 65 DAS with an additional dose of 40 kg N ha{ ¹ at 50 DAS, followed by dual-purpose maize var. DHM 117 grown alternately with fodder maize var. African Tall harvested at 60 DAS under the same crop geometry.

Keywords: *Crop geometry, Dual-purpose maize, Topping, Grain hardening.*

Relative Efficacy of Novel Insecticides against Spotted pod Borer, *Maruca vitrata* in Pigeonpea

***Panda, P.K[1]., Mondal, P[1]., Nayak, U.S.[2]**

[1] Dept. of Agricultural Entomology, Palli Siksha Bhavana, Visva-Bharati, Sriniketan;

[2] Joint Director of Research, OUAT, Bhubaneswar

Corresponding author e-mail: pkpanda2578@gmail.com

Abstract

A field experiment was conducted in Kharif, 2025 in Bhanjanagar of Ganjam district, Odisha on susceptible Pigeonpea variety, BRG-02 to evaluate the relative efficacy of some novel insecticides against the spotted pod borer, *Maruca vitrata*, a major pest of Pigeonpea. The treatments included Cyclaniliprole 10% DC, Fluxametamide 10% EC, (Chlorantraniprole 9.3 %+ Lamda cyalothrin 4.6%) ZC(Emamectin Benzoate 5% +Lufenuron 40%) WG, (Novaluron 5.25 %+ Indoxacarb 4.5%)SC, Flubendiamide 39.35% SC, Spinetoram 11.7 SC and (Profenofos 40%+ Cypermethrin 04 %) EC along with an untreated control. Two sprays were imposed: first at 50 % flowering and second at pod formation stage (21 days after 1st spray). Observations on live larval webs/plant, per cent pod damage and grain yield were recorded. The results indicated significant differences among the treatments where Fluxametamide 10 %EC (50 g a.i./ha) proved to be the most effective treatment, recording the lowest live web population after spraying with highest reduction of web/plant over control (83.64%), minimum pod damage (6.6%) and maximum grain yield (10.8 q/ha). Cyclaniliprole 10% DC and Novaluron 5.25 %+ Indoxacarb 4.5% SC also provided effective suppression of the pest resulting in lower pod damage (8.4% and 7.6%) and higher yield (9.2 q/ha and 8.8 q/ha), respectively. In contrast, Spinetoram and the conventional check treatment (Profenofos 40%+ Cypermethrin 04 %) EC were comparatively less effective. Lowest pod yield (4.2 q/ha) and highest pod damage (38.8%) was observed in untreated control plot. The study revealed that novel insecticides, Fluxametamide 10% EC and Cyclaniliprole 10 % DC proved superior in managing *Maruca vitrata* population and can be incorporated in integrated pest management programmes for enhancing Pigeonpea poductivity.

Keywords: *Maruca vitrata, Novel insecticides, Pigeonpea, Pod damage, Yield*

Adaptation strategies for Climate Change in India: Lessons from Haryana and Punjab

Polasa Bhuvanasri[1]*, Joginder Singh Malik[2] and Palnati Naveen Reddy[3]

[1]Ph. D Scholar, Department of Agricultural Extension Education, CCS-Haryana Agricultural University, Hisar. 125004. Haryana. ***Email- itsmebhuvanasri@gmail.com***

[2]Professor, Department of Agricultural Extension Education, CCS-Haryana Agricultural University, Hisar. 125004. Haryana. ***Email- jsmalik67@gmail.com***

[3]Ph. D Scholar, Department of Economics and Sociology, Punjab Agricultural University, Ludhiana-141004. Punjab. ***Email- naveenreddi1484@gmail.com***

Abstract

Among the most pressing global challenges of 21st century, climate change is profoundly altering agroecosystems, threatening biodiversity, and exacerbating socio-economic vulnerabilities at an unprecedented scale. The Intergovernmental Panel on Climate Change (IPCC, 2023) reported that global surface temperatures have increased by approximately 1.1°C above pre-industrial levels, intensifying the frequency and severity of extreme weather events. In India, agriculture supports nearly 46 per cent of the workforce (World Bank, 2024) and remains highly vulnerable to climate variability. According to the India Meteorological Department (IMD, 2024), the country experienced a rise of 0.7°C in average temperature during the last century, accompanied by increasing incidences of heat waves, erratic monsoons, and extreme rainfall events. NITI Aayog (2018) estimated that nearly 600 million Indians face high-to-extreme water stress, while the Central Ground Water Board (CGWB, 2024) reported

groundwater extraction rates of 163.76 per cent in Punjab and over 130 per cent in several districts of Haryana, indicating severe ecological imbalance. Furthermore, India ranked among the countries most vulnerable to climate risks in the Global Climate Risk Index (Germanwatch, 2021). In this context, the present study aimed to document various strategies for climate change adaptation in India and examine the climate change adaptation measures in Haryana and Punjab. Henceforth an attempt was made to divide the strategies within four domains of Crop Improvement (CI), Agricultural Advisory Services (AAS), Natural Resource Management (NRM) and Plant Protection (PP). Based on a comprehensive review of secondary data obtained from national and international organizations and also peer-reviewed scientific literature study aimed to provide formal evidence of mitigating and adaptation strategies in regions of Haryana and Punjab. Findings of study from Haryana and Punjab revealed that integrated adoption of resource-conserving technologies, climate-smart advisories, resilient crop varieties, and ecosystem-based management practices significantly contributes to sustainable productivity, climate risk reduction, and long-term agroecosystem sustainability.

Keywords: *Climate Change Adaptation, Sustainable Agriculture, Natural Resource Management*

Status of Occupational Diversification in Rural Areas of Northern West Bengal

Poulami Chhetri[1]*

[1]Department of Agricultural Economics, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar–736165, West Bengal, India

Corresponding author e-mail: tinnichhetri91@gmail.com

Abstract

In the small land holding, seasonal job and high burden on farming areas, diversification of occupation has emerged as a key livelihood strategy to sustain the rural livelihoods. In the context of Northern West Bengal, rural households have been increasingly shifting their economic activities from farming to non-farm activities, as a result of the growing unprofitability of agriculture, their shrinking land holdings and the shift in socio-economic status. In this paper the current situation of occupational diversification in Northern West Bengal and the recent changes of the labour market linked with transformation of employment in the rural areas of the region have been discussed. The study is based on secondary data and the data were gathered from Periodic Labour Force Survey (PLFS) and Agriculture Census reports and other government publications. The results suggested that agriculture is still the major occupation in rural areas, however, a gradual development towards secondary and tertiary sector activities is increasingly seen. Diversification of rural workforce towards construction activity, petty trade, transportation, services and other non-agricultural activities is happening in order to supplement household income and decrease reliance on agriculture. The analysis also shows that there are considerable gender gaps in labour force participation and employment opportunities. The marginalisation of small and fragmented land holdings has made livelihood diversification more imperative for the rural households. The paper concludes that sustainable livelihood security in Northern West Bengal requires strengthening of non-farm businesses in the rural areas, skill formation, greater involvement of women in the workforce and creation of employment opportunities in the region.

Keywords: *Occupational Diversification, Rural Livelihoods, Labour Force Participation, Northern West Bengal, Employment, Structural Transformation*

Eco- Friendly management of pulse beetle (*Callosobruchus chinensis* L.) infesting chickpea using selected vegetable oils.

Prapti Panja* and Tapan Kumar Hath
Department of Agricultural Entomology, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal, 736165.
Email: praptikutty3004@gmail.com

Abstract

An experiment was conducted on chickpea using four vegetable oils i.e., mustard, coconut, sesame and sunflower with two concentrations (5ml and 10ml /Kg seed) against *Callosobruchus chinensis* with a view to find out the best vegetable oil with suitable concentration for its ecofriendly management. In this regard, data were recorded on fecundity, % adult emergence, % adult mortality, developmental period, % seed germination, % weight loss of seed, % seed damage and analyzed following two factors completely randomized design (CRD). Results of the experiment showed that out of four vegetable oils tested, mustard oil caused significantly better reduction in fecundity (28 eggs / 2pairs of adult), % adult emergence (44.4%), % weight loss in 45 days after release (DAR) (1.19%) and % seed damage in 45 DAR (10.3%) and increment in developmental period (32.67 days) and % adult mortality (79.17%) than control and even better than that of other vegetable oils considered irrespective of concentration. Out of two concentrations, the highest concentration of 10ml/ kg of seeds, irrespective of vegetable oils, exhibited significant effect in reducing fecundity (46.39 eggs), % adult emergence (52.05%), % weight loss of seeds (1.42%), % seed damage (19.70 %) while augmenting the developmental days of insect (31.11 days). However, percent adult mortality and % seed germination showed insignificant effect as compared to the lowest concentration of 5 ml/ kg of seeds. The result of the interaction studies between vegetable oils and concentration indicated significant effects on % adult emergence, developmental period and % weight loss of seed. So, the mustard oil at the concentration of 10ml/kg of seeds has been emerged as the best vegetable oil for eco-friendly management of pulse beetle.

Keywords: *Vegetable oils, Callosobruchus chinensis, Chickpea, Seed damage*

Biophysical and Metabolic Consequences of Graded Ultrasonic Priming in Wheat Seeds

Kuntal Bera[1,2], Sanjoy Sadhukhan[1], Puspendu Dutta[2*]
[1]Department of Botany, Raiganj University, Raiganj-733134, Uttar Dinajpur, West Bengal, India.
[2]Department of Seed Science and Technology, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar-736165, West Bengal, India.
Corresponding author e-mail: pdutta.pph@gmail.com

Abstract

Conventional chemical seed-priming technologies, while effective in improving crop establishment, raise significant concerns regarding input cost, human safety, and long-term environmental sustainability. Ultrasonic seed priming, a clean, non-chemical, energy-based approach has emerged as a promising alternative that exploits the physical phenomenon of acoustic cavitation to modify seed physiology without chemical residues. Despite growing interest, the mechanistic basis of ultrasonic treatment on membrane integrity, reserve food mobilization, and enzymatic metabolism in wheat (Triticum aestivum L.) remains insufficiently characterized. The present study was therefore designed to evaluate the sub-

cellular and biochemical consequences of ultrasonic exposure through a set of complementary assays. Wheat seeds were subjected to ultrasonic treatment at 30 kHz and 50 kHz across a graded range of exposure durations. Post-treatment analyses focused exclusively on seed-level physiological and biochemical parameters. Across both frequencies, optimal treatment duration exhibits enhanced imbibition rates, driven by acoustic-cavitation mediated scarification (micro-poration) of the seed coat. While the seed coat was physically altered to facilitate water entry, internal viability was preserved at these moderate durations, as evidenced by a lack of Fast Green staining in the underlying embryo and endosperm. Furthermore, this controlled, early water uptake facilitated internal membrane repair mechanisms, resulting in lower leachate electrical conductivity compared to higher duration. This accelerated imbibition triggered robust metabolic activation, characterized by significantly elevated alpha-amylase activity and pronounced iodine-staining depletion in the endosperm, confirming rapid starch mobilization. Critically, at supra-optimal durations, this beneficial threshold was crossed, led to severe cavitation-induced cellular damage - evidenced by extensive Fast Green staining and a sharp spike in electrolyte leakage indicating plasma membrane damage. Consequently, this structural destruction may halt the biochemical germination cascade, leading to reduced amylase activity and residual iodine staining, collectively demonstrating that excessive sonication irreparably impairs both structural and metabolic seed health.

Keywords: *Ultrasonic priming, acoustic cavitation, wheat, seed leachate, alpha-amylase activity, fast green staining*

Antagonistic behavior of Bio-agents against *Colletotrichum falcatum* Went. Causing red rot disease in sugarcane for eco-friendly sustainable disease management

Rajneesh Kumar Awasthi[1], Satyendra Nath Singh[1], Sujeet Pratap singh[2]

[1]Department of Plant Pathology, P.G. College, Ghazipur, VBS Purvanchal University, Jaunpur (U.P.) INDIA- 233001

[2]Scientific Officer, Plant Pathology Division, Sugarcane Research Institute (U.P Council of Sugarcane Research), Shahjahanpur Uttar Pradesh, INDIA-242001

Corresponding Email- sujeetsugarcane@rediffgmail.com

Abstract

Sugarcane (*Saccharum officinerum*) is one of the most major cash crops of Uttar Pradesh; it is cultivated commercially on a large scale for sugar production. Red rot is a very destructive disease of sugarcane. Every year, millions of hectares of sugarcane crops are affected by red rot infection. The red rot disease has a significantly adverse impact on yield and productivity, resulting in a decline in sugar production. Bio-agents are a better option of red rot management compare to pesticides. This eexperiment were conducted in CRD design using dual-culture technique with three replications, to study the antagonistic behaviour of bio-agents (*Trichoderma harzianum,T.viride, T. virence, T. actroviride, Pseudomonas striata, Stenotrophomonas maltophilia* (B2132) against red rot of sugarcane. In current study it was found all the bio agents were significantly effective against red rot. *Trichoderma virence* numerically was found more effective with (77.77%) inhibition against *C. falcatum* followed by *T. harzianum* (75.18%), *T. viride* (71.48%), *Stenotrophomonas maltophilia* B2132 (70.37%). However, these aforementioned ecofriendly bio agents can be recommended for the management of red rot disease of sugarcane.

Keywords: *Antagonistic, Sugarcane, Red Rot, Colletotrichum falcatum.*

Quantification of Refrigeration Load in Potato Cold Storage under Operational Conditions

Rubia Khatun[1], Manoj Kumar Chourasia[1], Kingshuk Dhali[1,*]

[1]Faculty of Agricultural Engineering, Bidhan Chandra Krishi Vishwavidyalaya, Mohanpur, Nadia, West Bengal, India

****Corresponding author email: kingshukdhali@bckv.edu.in***

Abstract

The total refrigeration load of a cold storage facility is influenced by several factors, including structural heat gain, air infiltration, ventilation, product cooling requirements, operation of electrical equipment, and human occupancy. Conventional refrigeration load estimation methods generally assume fixed operating conditions and often fail to account for variations encountered in actual commercial operations, resulting in significant deviations between design and operating loads. Previous studies have reported suboptimal performance of commercial potato cold storage facilities, which may be attributed to variations in operational parameters such as loading rate, cool-down duration, and actual storage capacity utilization. The present study evaluated the influence of practical operating conditions on the refrigeration load of a potato cold storage facility with a storage capacity of 20,000 metric tonnes and an actual loading level of 97.2%. Two loading scenarios were investigated: (i) the actual loading pattern observed in commercial cold storage units and (ii) a uniform loading rate of 4% of total storage capacity per day, as prescribed by the National Horticulture Board (NHB) technical standards for agricultural cold storage facilities. In addition, two cooling rates were considered to assess their combined effect on refrigeration load during the transient cooling period. The results demonstrated that refrigeration load during the cool-down phase was highly sensitive to operating conditions. Under the irregular loading pattern observed in commercial practice, the transient refrigeration load exhibited pronounced fluctuations, whereas a comparatively smooth load profile was obtained under constant loading and cooling conditions. The observed variations were primarily governed by the loading pattern. Furthermore, the peak refrigeration load under irregular loading conditions was approximately 23% higher than that predicted using the constant loading rate recommended by NHB and commonly adopted in conventional refrigeration load calculations. These findings highlight the importance of incorporating realistic operating parameters into refrigeration load estimation for improved design accuracy and operational efficiency of potato cold storage facilities.

Keywords: *cold storage, refrigeration load, loading variation, realistic operating condition*

Field-efficacy of some selected insecticides against *Aphis gossypii* Glover on okra and their effect on natural enemies

S. Manohar[1*], Biswajit Patra[2]

[1]Department of Agricultural Entomology, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal-736165, India.

[2]Regional Research Station (Hill Zone), Uttar Banga Krishi Viswavidyalaya, Kalimpong, West Bengal- 734301, India.

[*]Corresponding author's Email: manoharsogala789@gmail.com

Abstract

Field experiments were conducted for two consecutive years during the *pre-kharif* seasons of 2025 and 2026 at the instructional farm of Uttar Banga Krishi Viswavidyalaya, West Bengal, India to evaluate the bio-efficacy of selected insecticides against *Aphis gossypii* Glover on okra. The effect of these selected insecticides on the natural enemies was also studied in okra ecosystem. The experiments were laid in Randomized Block Design (RBD) in three replications with eight treatments including control. Seven insecticides *viz.,*cyantraniliprole 10.26 % OD, flonicamid 50 % WG, spirotetramat 15.31 % w/w OD, tolfenpyrad 15 % EC, broflanilide 20SC, thiamethoxam 25WG and azadirachtin 5% were evaluated for their efficacy against okra aphid. Two sprayings were done at ETL of the pests using manually operated knapsack sprayer fitted with hollow cone nozzle in the early morning hours. The observation on the pest population was recorded before application as well as on different days after spraying. The results of the present investigations revealed that flonicamid 50 WG was found to be the most effective treatment for management of okra aphid followed by tolfenpyrad, spirotetramat, and cyantraniliprole. Broflanilide and thiamethoxam exhibited moderate efficacy, whereas azadirachtin was comparatively less effective. These insecticides did not adversely affect the coccinellid populations in okra ecosystem. The yield increase was commensurate with the performance of various treatments in the experiment. The results indicated that flonicamid is an effective and comparatively safer option for the management of *A. gossypii* in okra and can be incorporated into integrated pest management programmes for sustainable management of okra aphid.

Keywords*: Aphis gossypii, Flonicamid, Coccinellids, Okra, Bio-efficacy.*

Assessment of genotypic variation of some advanced wheat mutant lines against Foliar Blight disease under natural condition

Sagarneel Mookherjee[1*], Biplab Mitra[2], and Saikat Das[1]

[1]Department of Genetics and Plant Breeding, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal-736165, India

[2]Department of Agronomy, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal-736165, India

Corresponding author e-mail: sagarneelmookherjee@gmail.com

Abstract

Sustaining wheat productivity under changing climatic scenarios remains a major challenge, particularly in the eastern Gangetic plains of India. Wheat cultivation in this region is frequently subjected to severe disease pressure, resulting in significant yield losses. Among the biotic stresses affecting wheat in warm and humid regions, foliar blight has emerged as one of the most destructive diseases (Chowdhury et al., 2013). Foliar blight of wheat is a disease complex caused by several fungal pathogens. Among the different kinds of foliar blight diseases of wheat, Spot Blotch caused by *Bipolaris sorokiniana* (Sacc.) Shoemaker, is the most predominant one which may cause yield reduction upto 50% in case of susceptible cultivars under favourable climatic condition (Mishra et al,2021). The disease is fast spreading for which it is stretching towards the previously uncovered areas of moderate and temperate regions. There are chemical control measures available but their repeated use increases production cost and raises environmental and health concerns. Therefore, the development and identification of resistant or tolerant genotypes is one of the pragmatic options offering a sustainable and long-term solution for

disease management of wheat in India (Chowdhury, 2021). In this study, performance of 9 advanced mutant genotypes of wheat variety HI 1563 was evaluated for their tolerance towards spot blotch disease resistance under natural field condition. 03 checks viz., DBW 187 (popular variety), Sonalika (susceptible check) and the HI 1563 (parent) were used for comparison. The experiment was repeated twice i.e under normal sowing and late sowing condition for better assessment. Other morpho-phenetic traits such as Days to heading, Days to maturity, Plant height, Grains per spike, Spike length, Thousand grain weight and Yield were also measured for comparison.

Keywords: *Wheat, Foliar Blight disease, resistance breeding*

Horticulture 4.0: An Econometric Assessment and Socio-Technical Framework for India's Next Agricultural Growth Engine

Sagnik Baul[1*], Kabita Mondal[2]

[1]Department of Agricultural Extension, Uttar Banga Krishi Vishwavidyalaya, Pundibari, Coochbehar 736165, West Bengal, India

[2]Department of Agricultural Extension, College of Agriculture, Uttar Banga Krishi Vishwavidyalaya, Majhian, Dakshin Dinajpur 733133, West Bengal, India

****Corresponding author e-mail: sagnikbaul9@gmail.com***

Abstract

This study evaluates the macroeconomic impact of India's horticultural sector and establishes an institutional framework to overcome the grassroots barriers limiting "Horticulture 4.0" technology adoption. Occupying only 13.3% of the cropped area but generating 34.45% of agricultural Gross Value Added (GVA), horticulture permanently outpaced national foodgrain volumes in 2012-13, reaching an anticipated 354.74 MT in 2023-24. Log-linear trend modelling (2014-2024) reveals a highly consistent production trajectory with a constant Compound Annual Growth Rate (CAGR) of 1.182% ($R^2 = 0.98546$, $F = 677.75$, $P < 0.001$). Parallel ordinary least squares (OLS) regression models confirm that while nominal output at current prices explains 93.04% of current agricultural GVA variance ($R^2 = 0.9304$, $\hat{a}_1 = 0.0515536$, $P = 0.007969$), real output at constant prices explains a dominant 98.17% ($R^2 = 0.981735$, $\hat{a}_1 = 0.0348300$, $P = 0.001053$). This econometric divergence proves that horticulture functions as a structurally resilient growth engine driven by real volume expansion rather than temporary market price spikes. However, the grassroots deployment of high-tech advancements including LoRaWAN sensor networks, automated vertical farming, deep learning foliar diagnostics (99.18% accuracy), and blockchain logistics remains heavily constrained by steep initial capital expenditures and severe digital illiteracy among fragmented smallholders. To bridge this gap, this paper introduces a socio-technical mapping matrix and a three-pillar delivery framework that shifts national policy toward communal infrastructure subsidies under MIDH, transitions capacity building to experiential digital Farmer Field Schools, and leverages structural aggregation through Farmer Producer Organizations (FPOs) to successfully scale and de-risk advanced post-harvest value chains.

Keywords: *Macroeconomic impact; Horticulture Growth Engine; OLS Regression; CAGR Trends; Horticulture 4.0; Socio-Technical Matrix.*

Linking Botanical Origin with Nutritive Quality: A Study on West Bengal Honey

Samrat Saha[1*], Simanta Das[2], Biswajit Majumder[3], Tapamay Dhar[4], Nripendra Laskar[1], Nilanjana Chaudhuri[5], Somnath Mandal[2], Arunava Ghosh[5]

[1]Department of Agricultural Entomology, Uttar Banga Krishi Viswavidyalaya, Pundibari-736165, West Bengal, India

[2]Department of Biochemistry, Uttar Banga Krishi Viswavidyalaya, Pundibari-736165, West Bengal, India

[3]Central Instrumentation Centre, Uttar Banga Krishi Viswavidyalaya, Pundibari-736165, West Bengal, India

[4]Regional research Station (OAZ), Uttar Banga Krishi Viswavidyalaya, Mathurapur 732203, West Bengal, India

[5]Regional research Station (TZ), Uttar Banga Krishi Viswavidyalaya, Pundibari-736165, West Bengal, India

Corresponding author e-mail: isamratsahamtb43@gmail.com

Abstract

Honey is a critical health-promoting supplementary food from nature, which has always been questioned for its quality and adulteration status. Therefore, the present study was conducted to evaluate the nutritional status and mineral composition of 29 raw honey samples from West Bengal, India and 4 popular branded honey samples for a comparative assessment. The raw honey samples were first analyzed for their botanical origin through quantitative melissopalynological assessment and categorized based on the botanical origin and honey bee species. The honey samples were varied significantly in their nutritional composition, which was linked with their botanical origin. The multifloral *Tetragonula* honey was found to be outperforming other honey samples in its composition of bioactive compounds, including phenol, flavonoid, ascorbic acid, and antioxidant content, achieving a maximum relative antioxidant capacity index (RACI) of 0.98. The honey colour was found to be a potential indicator of honey's bioactive constituents, as this parameter showed significantly positive correlations ($p>0.05$) with different bioactive constituents. Although honey is not a rich source of protein, however in raw multifloral *Apis florea* honey, it can reach up to 0.95%. Considering the mineral constituents, the multifloral *A. florea* honey samples were recorded with significantly greater amount of N, P, K, and Ca, while *Tetragonula* honey samples were rich in Mg. The *Sesamum* honey and *Eucalyptus* honey demonstrated a markedly higher concentration of Cu and Mn, respectively. In contrast, the adulterated honey samples exhibited an extremely high concentration of S and Al, which could serve as an indication of the presence of refined sugar. The results distinctly emphasize the superior nutritional quality of multifloral *Tetragonula* and *A. florea* honey, which remain underutilized in West Bengal, indicating the scope associated with the production of these honey categories.

Keywords: *Bioactive compounds, Honey, Mineral, Multifloral, Nutrient, Physico-chemical*

Optimization of the concentration of Chitosan and *Aloe vera* gel as edible coating on Paprika (*Capsicum annuum* L.) in storage

Sanasam Angousana[1]*, Mutum Preema Devi[1], Prodyut Kumar Paul[1], Arpan Kabiraj[1], Ranjit Chaterjjee[2], Suchand Datta[2], Sankalpa Ojha[3] and Himadri Shekhar Konar[4]

[1]Department of Pomology and Post- Harvest Technology, [2]Department of Vegetable and Spice crops,

[3]Department of Agricultural Statistics and [4]Faculty of Technology, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal
Email: angousanasanasam@gmail.com

Abstract

Paprika (*Capsicum annuum* L.) is native to Central America and belong to Solanaceae family and it is known for its cholesterol free, low-calorie value and high amount of vitamins (A, C and E) nutrition with bioactive compound (carotenoids, polyphenols, and alkaloids). Paprika undergoes several physiological and biochemical changes after harvest that reduce the shelf life of fruit. Application of edible coatings to fruits delays senescence by minimizing transpiration and respiration, which helps maintain quality and prolong shelf life. The present experiment was conducted on "Optimization of the concentration of Chitosan and *Aloe vera* gel as edible coating on Paprika (*Capsicum annuum* L.) in storage" in Department of Pomology and Post-Harvest Technology of Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal during, 2023-2024 and 2024-2025. The physico-chemical characteristics of fresh green paprika were evaluated prior to storage and after application of both combination of Chitosan and *Aloe vera* gel concentration range from 1-3% applied by dipping method with time duration from 5-15 minutes on fresh green paprika and optimized using Response Surface Methodology (RSM) by evaluating its effects on moisture retention and texture whereas average mean value of physico-chemical attributes are presented. Our current investigation showed that the average fruit weight was (26.81-26.98 g), moisture content (92.53-92.61%), texture values ranged from (5.94-5.96 N). With respect to biochemical attributes, the total soluble solids (TSS) ranged from (7.01-7.03 °B), total sugar content varied from (5.98- 6.16%), The ascorbic acid content was recorded at 27.46 mg/100 g, while â-carotene content ranged from (21.52-21.57 µg/g). Our present study also demonstrated that combination of 3% Chitosan and 2% *Aloe vera* gel showed minimum percentage change in moisture content. However, in terms of texture, minimum percentage change in texture was recorded in 2% Chitosan and 2% *Aloe vera* gel. These findings indicate that edible coating effectively preserved the moisture content and textural quality of fresh green paprika in storage.

Keywords: *Paprika, edible coating, Chitosan, Aloe Vera gel, RSM*

Willingness of Farmers to Transition Towards Organic Farming in Jorhat, Assam

Sandiponi Tasha[1]*, Prof. Avani Maniar[2], Dr. Mayuri Bora[3]

[1]Department of Extension and Communication, Faculty of Family Community Sciences, The Maharaja Sayajirao University of Baroda, Vadodara-390002, Gujarat;
sandiponi-extcommphd@msubaroda.ac.in

[2]Department of Extension and Communication, Faculty of Family Community Sciences, The Maharaja Sayajirao University of Baroda, Vadodara-390002, Gujarat;
maniar.avani-extcomm@msubaroda.ac.in

[3]Department of Extension Education and Communication Management, Faculty of Community Science, Assam Agricultural University, Jorhat-785013, Assam;
mayuri.bora@aau.ac.in

****Corresponding author : sandiponi-extcommphd@msubaroda.ac.in***

Abstract

The transition towards organic farming has gained increasing importance in the context of environmental sustainability, food safety, and human health. The present study was conducted to assess the willingness of farmers to transition towards organic farming in Jorhat district of Assam. A total of 60 vegetable farmers were selected using purposive and snowball sampling techniques, and data were collected through a structured interview schedule. The findings revealed that a majority of the farmers expressed interest in reducing the use of agrochemicals (70.00%) and acknowledged their harmful effects on human health (75.00%). Similarly, 70.00 per cent of the respondents preferred organic farming for its long-term social and health benefits. However, considerable uncertainty was observed regarding the adoption of organic farming, as 55.00 per cent of the farmers were undecided about accepting temporary yield reductions and 56.67 per cent were unsure about converting a major portion of their farmland to organic methods within the next three years. Farmers' willingness to adopt organic farming increased substantially when supportive conditions such as proper training, financial assistance, technical guidance, and easy availability of organic inputs were ensured. The study concludes that although farmers possess a favourable orientation towards organic farming, their readiness to adopt it remains conditional and influenced by economic, technical, and institutional factors. Strengthening extension services, capacity-building programmes, and support mechanisms can enhance farmers' willingness and facilitate a smoother transition towards organic farming.

Keywords: *Organic Farming, Farmers' Willingness, Adoption Readiness, Extension Services, Sustainable Agriculture, Assam*

Effect of Temperature and pH on the Growth of *Alternaria lini* causing Alternaria Blight of Linseed

Himanshu Kumar Gupta, Satyerndra Nath Singh*

Department of Plant Pathology, P.G. College, Ghazipur, VBS Purvanchal University, Jaunpur, U.P.-233001

****Corresponding auther e-mail: satyendran2010@gmail.com***

Abstract

Alternaria blight is a very harmful disease of plants caused by *Alternaria lini* fungus. It ruins linseed crops and decreases their seed yield. For protecting plants from this disease, it is necessary to find out which environmental conditions are best for the fungus. This lab experiment checked how various temperatures from 15°C to 35°C and pH levels from 4 to 8 affected the growth and spore production (sporulation) of *Alternaria lini*. It was found that temperature, humidity and other environmental factors very strongly influence the activity of the pathogen. *Alternaria lini* growth temperature optimum was found to be 25°C with maximum growth 39.69 mm; a rise in temperature to 35°C effected a major decline in growth only 13.00 mm. The sporulation of the fungus was quite high at 25°C and 30°C while at 15°C and 35°C it was very low. Besides this, the shape of the colony which was a perfect circle at low temps changed to uneven at higher ones.The fungus felt at ease with pH levels that were slightly acidic or neutral. The most growth was recorded at pH 6 (36.33 mm) and pH 7 (34.00 mm). Strong acid pH (pH 4) limited the fungus growth to a mere 11.67 mm. The maximum spores production was noticed at pH 6 and 7 but low at pH 4, 5 and 8.As a result, the growth and reproduction of *Alternaria lini* is favoured by 25°C temperature and pH values of 6.0 to 7.0. This information can be used to help the

farming community to take protective measures for their linseed crops by predicting the spread of this disease through the field by the researchers.

Keywords: *Alternaria lini, Linseed blight Temperature, pH, Spores.*

Dual Purpose Bacterial Biopriming for Soil-Plant Relationship: Vigor Enhancement and Thermal Buffering of Rhizosphere

Shouvik Baidya[1], Kapudeep Karmakar[2], Binayak Chakraborty[2], Deepak Kumar[3], Nipa Biswas[4], Bratati Chowdhury[5]

[1]Department of Soil Science and Agricultural Chemistry, Uttar Banga Krishi Viswavidayalaya, Coochbehar, India-736165

[2]Regional Research Station, Terai Zone, Uttar Banga Krishi Viswavidayalaya, Coochbehar, India-736165

[3]Department of Biochemistry, College of Agriculture, Uttar Banga Krishi Viswavidayalaya, Balurghat, India-733133

[4]Department of Seed Science and Technology, Uttar Banga Krishi Viswavidayalaya, Coochbehar, India-736165

[5]Faculty of Engineering, Uttar Banga Krishi Viswavidayalaya, Coochbehar, India-736165

****Corresponding author e-mail: shouvikbaidya2000@gmail.com***

Abstract

Low soil temperature and its fluctuation can negatively impact the growth of seedlings. The district of Cooch Behar (India), belonging to the Cwa zone (according to Koppen's classification), receives several cold waves during winter. Our previous study demonstrated that a constant temperature of 20 °C (chilling but not freezing) can cause a loss in the vigor of tomatoes. Since the temperature of the soil is not uniform throughout the day, we hypothesized that the duration of cold exposure can have variable effects on seed vigor. It was observed that increasing the duration of cold stress can slow down the germination process and reduce vigor. This was due to the cold-mediated damage to cell membranes (due to dehydration) which caused electrolyte leakage and reduced levels of glutathione reductase. In this regard, biopriming seeds with microbes that produce exopolysaccharide (EPS) can be useful as it can form a protective layer on the seeds. Indigenous EPS-producing bacteria, *Bacillus*, *Phytobacter* and *Priestia* sp., were used for biopriming. *Priestia* and *Phytobacter* sp. not only reduced the electrolyte leakage but also increased the levels of antioxidant genes. This improved the germination speed and vigor. In a field trial, the rhizosphere of the seedlings pretreated with bioinoculants displayed a reduced thermal fluctuation compared with the untreated seeds. The seedlings treated with bioinoculants grew faster in soil in spite of low soil temperature. This can reduce the nursery time of seedlings.

Keywords: *Bacillus; cold stress; Phytobacter; Priestia; soil; vigor.*

Assessment of Zinc Use Efficiency among Rice Cultivars in Transplanted Rice under the New Alluvial Region of West Bengal

Sneheta Basak[1]*, N. Chatterjee[1], A. Maji[1] and S. Saha[1]

[1]AICRP on Micro- and Secondary Nutrients & Pollutant Elements in Soils and Plants, Directorate of Research, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, West Bengal

****Email of the corresponding author: snehetabasak21@gmail.com***

Abstract

Zinc (Zn) deficiency is one of the major micronutrient constraints limiting rice productivity and nutritional quality in alluvial soils. The study aims to evaluate the performance of different rice cultivars under varying zinc (Zn) management practices in transplanted rice. A field experiment was conducted by growing rice at the Central Research Farm, Bidhan Chandra Krishi Viswavidyalaya (BCKV), Gayeshpur, Nadia, West Bengal during kharif season in 2026. The experiment was carried out in the new alluvial sandy loam soil using a split-plot design with three replications and six different rice cultivars, viz., IET-4786, CR Dhan 310, CR Dhan 311, MTU-7029, Bidhan Suruchi, and Pratikshya, under two different Zn management practices. The recommended fertilizer dose of 60:30:30 kg N:P, O… :K, O ha{ ¹ was applied through urea, SSP, and MOP. Zinc treatments included soil application of Zn @ 5 kg ha{ ¹ as basal and foliar application of 0.5% ZnSO,, ·7H, O at maximum tillering and panicle initiation stage. Across all varieties, MTU-7029 resulted in higher grain yield (2.9 t ha^{-1}) and Pratikshya resulted in highest straw yield (6 t ha^{-1}). Soil application (5 kg ha¹ as basal) resulted 15.0 to 44.0% increase in grain Zn, while foliar application (0.5% $ZnSO_4.7H_2O$) at maximum tillering and pre-flowering stages increased grain Zn content (37.0-96.0%) in the tested cultivars with highest enrichment was observed in Bidhan Suruchi (53.9 mg kg¹) as compared to soil application. Foliar application of 0.5% ZnSO,, ·7H, O resulted in a significant increase of other micronutrients in rice plants (Fe, Cu, Mn). Therefore, in transplanted rice grown in new alluvial sandy loam soil, foliar application of 0.5% ZnSO,, ·7H, O proved more effective than soil application in enhancing grain Zn enrichment and improving micronutrient uptake (Fe, Cu, and Mn).

Keywords: *Rice cultivars, soil application, foliar application, new alluvial zone, grain yield, micronutrient management.*

Screening of various priming agents for improved germination indices of wheat

Soham Mukherjee[1*], Nupur Niharika[1], Kuntal Bera[1,2], Lavkush Jogi[1] and Puspendu Dutta[1]

[1]Department of Seed Science and Technology, Uttar Banga Krishi Viswavidyalaya, Pundibari – 736165, Cooch Behar, West Bengal, India

[2]Department of Botany, Raiganj University, Raiganj – 733134, Uttar Dinajpur, West Bengal, India

[*]***Corresponding author e-mail: soham.2k14@gmail.com***

Abstract

Wheat (*Triticum aestivum* L.) is predominantly cultivated as a winter crop in West Bengal, where temperature stress poses a significant threat to productivity along with other biotic and abiotic stresses. When sown late, i.e., during December to January, at early crop establishment, chilling stress impairs leaf growth and seedling development, which significantly impacts crop growth and yield. Seed priming has emerged as a cost-effective and practically viable strategy to alleviate the adverse effects of different stress conditions by enhancing germination efficiency and stress tolerance in early seedling stages, with residual benefits extending to later growth phases through better crop stand and yield. To identify the most effective priming agents and their optimum concentrations, a systematic laboratory experiment was conducted using HD-2967, a widely cultivated wheat variety. Seeds were subjected to priming with eleven chemically distinct priming solutions with predetermined concentrations — Mannitol, Glycine Betaine, Gibberellic Acid, Salicylic Acid, Potassium Nitrate, Polyethylene Glycol, Calcium Chloride, Ascorbic Acid, Trehalose, Melatonin, and Sorbitol. Seeds were soaked for eight hours in the

respective priming solutions and subsequently placed in Petri dishes under controlled conditions of 25 ± 1°C for an eight-day germination period. Daily germination counts were taken and seedling vigour indices were recorded at the end to compare against unprimed control seeds. Comprehensive germinometric analysis revealed concentration-specific variations in germination performance across all priming treatments. Principal Component Analysis (PCA) biplot was utilized to integrate multiple germination indices and facilitate the selection of optimal concentrations for each priming agent. Based on the observations, it has been recorded that Melatonin and Potassium nitrate showed comparatively better effect as priming agents than the rest, although not significantly better than most of the agents. The selected concentrations are subjected to further studies to observe their effects on this crop under different environmental conditions and their relevant stressors.

Keywords: *Wheat, Seed priming, chilling stress, seedling vigour, germinometric analysis, PCA Biplot*

Performance of Rice as Influenced by Polyhalite (Poly4) as a Source of Potassium in Lower Gangetic Plains of West Bengal (India)

Soumen Bera*, Sibsankar Das and Susmit Saha
College of Agriculture, Bidhan Chandra Krishi Viswavidyalaya, Burdwan, West Bengal, India
Email: bera.soumen@bckv.edu.in

Abstract

A two-year field experiment (*Kharif,* 2021 and 2022) was conducted in the Lower Gangetic Plains of West Bengal, India, to evaluate the performance of rice (variety MTU-1153) influenced by Polyhalite (Poly4) as a multi-nutrient potassium (K) source. The study followed a Randomized Complete Block Design with eight treatments replicated thrice, comparing various combinations of Poly4 and Muriate of Potash (MOP) against traditional Farmers' Practice (FP) and the Recommended Dose of Fertilizers (RDF). Results revealed that replacing or blending conventional K with Poly4 significantly enhanced vegetative growth, yield attributes, and grain quality. Treatment T8 (Recommended Dose of N and P + 100% K via Poly4) achieved the highest pooled grain yield (6.62 t/ha) and stover yield (9.59 t/ha), considerably outperforming Farmers' Practice (5.40 t/ha). This improvement was supported by superior growth traits at active tillering, including a maximum Leaf Area Index of 3.48 and dry matter accumulation of 563.86 g/m², alongside an increased number of effective tillers (216.28/m²) and filled grains per panicle (119.72). Furthermore, Poly4 application notably enhanced resistance to crop lodging and improved post-harvest soil nutrient status (available N, P, K, and S). Grain qualitative traits, including protein (6.8%), starch (81.02%), and amylose (22.13%), were also significantly optimized under Poly4-based management. Economically, Poly4 demonstrated higher Benefit-Cost ratios and superior agronomic K efficiency. The study concludes that Polyhalite is an economically viable, sustainable alternative to conventional K fertilizers for optimizing rice productivity and grain quality in the region.

Keywords: *Rice, Polyhalite, Potassium, Yield, Lodging resistance, Quality*

Effect of Plant Growth Promoting Substances and Spraying Frequencies on Growth, Yield and Yield Attributes of Pointed Gourd (*Trichosanthes dioica* Roxb.)

Sourav Mollick*, Shibnath Basfore
Department of Vegetable and Spice Crops,
Uttar Banga Krishi Viswavidyalaya, Coochbehar, West Bengal - 736165, India.

*Corresponding:souravmollick2020@gmail.com

Abstract

Pointed gourd (*Trichosanthes dioica* Roxb.) is an important perennial cucurbit widely cultivated in eastern India for its nutritional and economic value. A field experiment was conducted at the Instructional Farm, Faculty of Horticulture, Uttar Banga Krishi Viswavidyalaya, Pundibari, West Bengal, during 2024–25 to evaluate the effect of plant growth promoting substances on growth, flowering and yield of the crop. The experiment was laid out in a split-plot design. Main plots consisted of two foliar spraying frequencies: A• (two split applications at 45 and 75 DAP) and A, (single application at 60 DAP). Subplots included ten bio-stimulant and plant growth regulator (PGR) treatments: water-spray control, Jeevamrit (10%), Vermiwash (10%), humic acid (50 mg L{ ¹), brassinosteroids (2 ppm), amino acids (2 g L{ ¹), seaweed extract (3 mL L{ ¹), naphthaleneacetic acid (NAA; 100 ppm), ethrel (300 ppm) and gibberellic acid (GA*f*; 200 ppm). Results showed that spraying frequency significantly affected crop performance, with A (two sprays) outperforming A, across most traits. Among treatments, NAA (100 ppm) recorded maximum vine length (7.14 m), highest nodes per vine (61.66) and longest fruits (11.63 cm). Ethrel (300 ppm) promoted earliness, showing the lowest node number for first female flower appearance (10.25) and minimum days to 50% female flowering (99.66 days). Seaweed extract (3 mL L{ ¹) was most effective for yield, recording highest fruits per plant (135.33), average fruit weight (49.26 g), yield per plant (6.65 kg), and projected yield (157.14 q ha{ ¹). The interaction of A with seaweed extract produced the maximum yield per plant (7.32 kg) and projected yield (174.28 q ha{ ¹) followed closely by NAA and Ethrel under A. The control recorded the lowest values for all parameters.

Keyword: *Pointed gourd, plant growth substances, foliar application, seaweed extract, ethrel, naphthaleneacetic acid.*

Heterosis in gladiolus- A Critical Review

Sreya Konar[1]* Arpita Mandal Khan[2]

[1]M. Sc., Department of Floricultural Medicinal and Aromatic Plants, Faculty of Horticulture, Uttar Banga Krishi Viswavidyalaya (UBKV), Pundibari, Cooch Behar, West Bengal, India.

[2]Department of Floricultural Medicinal and Aromatic Plants, Faculty of Horticulture, Uttar Banga Krishi Viswavidyalaya (UBKV), Pundibari, Cooch Behar, West Bengal, India.

Correspondence author's E-mail: bristi99506488@gmail.com

Abstract

Gladiolus *(Gladiolus grandiflorus L.)* is one of the most important cut flower crops and also ideal both for garden display and floral arrangements for table and interior decoration as well as making high quality bouquet. The growing demand for superior cultivars with enhanced floral quality and yield has emphasized the significance of heterosis breeding in gladiolus improvement programs. Heterosis also known as hybrid vigor is a natural phenomenon whereby hybrid offsprings of genetically diverse individuals display improved physical and functional characteristics relative to their parents. Several studies have reported considerable variability and heterotic effects for important flowering and yield traits in gladiolus. Positive standard heterosis in spike length was noted in crosses Green Pasture × Regency and Suchitra × Melody while negative standard heterosis was noted in Cignet × Little Fawn for the same trait. Positive heterosis was observed in Suchitra × Melody for rachis length, Standard positive heterosis was noted in Pearl Beauty × Luck Shemrock, and Mayur × Howard for number of

florets per spike while negative heterosis was observed in White Oak × Flirt. At the same time, the expression of both positive and negative heterosis for certain traits indicates the involvement of additive as well as non-additive gene actions in the inheritance. Previous investigation also highlighted the combining ability, heritability, and genetic advance play an important role in identifying superior parental lines and promising hybrid combinations as seen in OPRC09 derived from 'Amsterdam' × 'Advanced Red' with superiority in leaf length, leaf width, crown diameter, leaf number, days to germination, cormlet weight, and diameter and in OPRC04 derived from 'White 'Prosperity' × 'Advance Red' were superior in cormlet yield. Overall, heterosis breeding is a promising strategy for development of high-yielding, aesthetically superior, and commercially valuable gladiolus cultivars for the expanding floriculture industry.

Keywords: *Gladiolus, heterosis, breeding, hybrid vigor, combining ability, genetic variability, heritability.*

A mini load cell for assessing tensile force in restricted space agricultural applications

Sujit Hensh[1*], Hifjur Raheman[2]

[1]College of Agriculture, Bidhan Chandra Krishi Viswavidyalaya, Burdwan, West Bengal, 713101, India

[2]Department of Agricultural and Food Engineering, Indian Institute of Technology Kharagpur, West Bengal, 721302, India

****Corresponding author email: s.hensh1986@gmail.com***

Abstract

Most commercial load cells are relatively large and heavy, making them unsuitable for applications where the weight and size of the load cell are critical factor. To address this issue, a load cell weighing 45 g and measuring 64.5 mm × 40 mm × 8 mm was designed and developed for accurate measurement of tensile loads up to 100 N in confined spaces. EN24 steel was selected as the material due to its mechanical strength and stability. A full-bridge Wheatstone configuration was formed using four active strain gauges, each with a resistance of 350 &!. The load cell was calibrated using standard weights, and the calibration curve demonstrated excellent linearity with a coefficient of determination (R^2) of 0.99. Key performance metrics were observed as follows: non-linearity of 0.0208%, non-accuracy of 0.151%, hysteresis of 0.025%, repeatability of 0.046%, and sensitivity of 0.027 mV/V per N all within acceptable ranges for commercially available load cells. Validation was performed by comparing the output of the developed load cell with that of a standard S-type load cell. The resulting Mean Absolute Percentage Error (MAPE) and Root Mean Square Error (RMSE) were 0.369% and 0.0054 N, respectively, indicating strong agreement between the two devices. Further testing involved measuring the pulling force of a solenoid in laboratory and measuring clutch actuating force in an electric paddy seeder in limited space. These results affirm that the developed load cell is suitable for precise tensile load measurements below 100 N, especially in applications constrained by limited space.

Keywords: *load cell, strain gauge, non-linearity, non-accuracy, hysteresis*

Combined effect of biostimulants and plant bio-regulator on flowering of temperate *Freesia* in subtropical plains of West Bengal, India

Sumana Adhikary
Ph.D Research Scholar, Department of Floriculture, Medicinal and Aromatic Plants, Faculty of Horticulture, Uttar Banga Krishi VIswavidyalaya
Corresponding author's mail id: sumanaadhikary8920@gmail.com

Abstract

Freesia (*Freesia hybrida*) is an important bulbous ornamental crop valued for its attractive inflorescence, vibrant colours and pleasant fragrance. The successful cultivation of temperate Freesia in the subtropical Terai plains of Eastern India is constrained by environmental conditions like shorter winters and prolonged monsoons, which are less favourable for Freesia's optimal growth and development. Biostimulants, such as - chitosan and humic acid often expedite crop cycles while improving growth and development. Gibberellic acid also promotes growth, early flowering and development in geophytes. To harness the potentials of those three agro-inputs on adaptation of temperate Freesia in subtropical plains, this experiment was conducted. The site of the field trial was the Instructional Farm, Department of Floriculture, Medicinal and Aromatic Plants, Faculty of Horticulture, Uttar Banga Krishi Viswavidyalaya, West Bengal, India during the winter season to evaluate the combined effect of different molecular weight grades of chitosan and varying concentrations of humic acid in conjunction with GA*f* (100 ppm) on flowering attributes of Freesia under the subtropical plains of West Bengal. Seventeen treatments comprising four grades of chitosan (high, medium, low molecular weight and nano-chitosan), four levels of humic acid (0, 2, 4 and 8 g/l) and GA*f* @100ppm along with a control were assessed. Results indicated significant improvement in flowering characteristics over the control. The treatment consisting of low molecular weight of chitosan (1.5%) combined with humic acid at 2 g/l and GA*f* at 100 ppm recorded the highest spike length (31.47 cm) and maximum number of florets per spike (9.27). Nano grade of chitosan (1.5%) combined with GA*f* @100ppm produced the longest vase life (5.0 days). Application of medium molecular weight of chitosan with 4 g/l humic acid and 100ppm GA_3 resulted in the earliest flower bud initiation (119.11 days after planting). The findings suggested that integration of biostimulants with plant bioregulators can improve the flowering performance of Freesia under subtropical conditions and may provide a sustainable strategy for commercial cultivation.

Keywords*: Freesia, Freesia hybrida, biostimulant, chitosan, humic acid, gibberellic acid*

Role of Smart Aeration Technologies in Enhancing Income of Smallholder Farmers in North-East India

Suranjit Roy[1*], Avinash Kumar[2]
[1*] Research Scholar, Department of Agricultural Engineering, Assam University, Silchar, Assam
[2] Assistant Professor, Department of Agricultural Engineering, Assam University, Silchar, Assam
[*]***Corresponding author: suranjitroy856@gmail.com***

Abstract

About 70% of the rural population in North East India comprising states like Assam and Sikkim is engaged in agriculture. The sector is plagued with problems like poor soil aeration, water logging and lack of mechanization. Proper aeration is necessary to improve crop yields but is done by inefficient

conventional methods. We proposes a framework for Smart Aeration Systems (SAS) IoT-enabled to improve aeration efficiency and support economic upliftment of the smallholder farmers in the regime. Automated aeration interventions can increase paddy production by 15-25%, reduce fish mortality in aquaculture by as much as 40%, and cut down on manual oxygenation labor expenses by roughly 60%. It also help deliver on India's NDCs under the Paris Agreement by reducing methane emissions from anaerobic soils. The socio-economic analysis of the study suggests that availability of affordable SAS coupled with government programs such as SMAM and NERAD can substantially improve income resilience of marginal farmers especially women and indigenous groups in jhum cultivation. SAS integrates real-time soil oxygen and moisture sensors with automated micro-aeration pumps and communication modules based on ESP32 Arduino and data analytics to regulate aeration in paddy fields, fish ponds and greenhouses. The framework is targeted at improving access in remote North Eastern terrains using IoT and solar energy. It includes aerators for aquaculture with feedback control of dissolved oxygen, subsurface aeration tiles for water-logged soils and a mobile app alert system that enables farmers to intervene in a timely manner.

Keywords: *Aquaculture, IoT in Agriculture, North East India, Precision Farming, Smart Aeration System.*

Metal Contaminated Soil Emphasizes Heavy Metal Loading in Leafy Vegetables Grown in Dhapa, Kolkata

***Susmit Saha**

*College of Agriculture, Extended Campus of BCKV, Burdwan Sadar, Purba Bardhaman-713101, West Bengal, India

****Email of Corresponding author: susmit.bckv@gmail.com***

Abstract

Leafy vegetables accumulate metals from soil to their edible parts more efficiently than other crops. A survey has been conducted in 2021-22 and 2022-23 to estimate the heavy metal accumulation in leafy vegetables commonly grown in the metal contaminated soils of Dhapa, Kolkata, West Bengal. Edible parts (leaves) of selected crops have been collected for consecutive two growing seasons (2021-22 and 2022-23), thoroughly washed with dilute acid and double distilled water to remove all dirts, oven dried at 60°C, dry ashed, and further analysed for tissue concentration of heavy metals. The degree of heavy metal accumulation in tested tissues was in the order: Zn > Cu > Cr > Pb > Ni > Cd. Among the crops, tested for those two seasons, spinach showed maximum loading of heavy metals followed by red amaranthus and others. Coriander leaves, leaves of bottle gourd and raddish exhibited comparatively lower accumulation potential of heavy metal than spinach and amaranthus. The edible parts of all the tested crops have crossed the safe limit of heavy metal content in leaf tissues confirming an alarming health threat to the consumers.

Keywords: *accumulation, contaminated soil, health threat, heavy metal, leafy vegetables*

Studies on Pest Complex and Population Fluctuations of Major Insect Pests of Tomato in Relation to Weather Variables

***T. Mohan Kumar[1], S. Pal[2]**

[1]Department of Entomology, Uttar Banga Krishi Viswavidyalaya (UBKV), Pundibari, Coochbehar, West Bengal-736165, India.

[2]Directorate of research (RRS- TZ), Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar 736165, West Bengal, India
Corresponding Author: T. Mohan Kumar
Email: mohan.agri.ento@gmail.com

Abstract

Tomato (*Solanum lycopersicum* L.) is one of the most important vegetable crops cultivated worldwide; however, its productivity is severely affected by a diverse range of insect pests. A field study was conducted during Rabi 2025–26 at the instructional farm of Uttar Banga Krishi Viswavidyalaya, Pundibari, West Bengal, to investigate the pest complex and population dynamics of major insect pests in relation to prevailing weather parameters. Weekly observations on insect pests and natural enemies were recorded from transplanting until harvest. Meteorological data, including maximum and minimum temperatures, relative humidity, and rainfall, were collected from the university meteorological observatory to study population fluctuations in relation to weather variables. A total of twelve insect pest species belonging to four orders and ten families were recorded from the tomato ecosystem. Among these, green peach aphid (*Myzus persicae*), serpentine leaf miner (*Liriomyza trifolii*), tobacco caterpillar (*Spodoptera litura*), fruit borer (*Helicoverpa armigera*), and tomato pinworm (*Tuta absoluta*) were identified as major pests, while whitefly (*Bemisia tabaci*), thrips (*Thrips tabaci*), and hadda beetle (*Henosepilachna vigintioctopunctata*) occurred as moderate pests. The population of aphids reached its peak (68.90 aphids/10 cm twig) during the 5th Standard Meteorological Week (SMW). Among foliage feeders and borers, leaf miner infestation peaked at 20.60 mines per plant during the 6th SMW, while tomato pinworm infestation increased progressively and reached a maximum of 7.86 per cent during March. Population trends indicated that most pests exhibited greater abundance under moderate temperatures (26–30°C), lower rainfall, and relatively low minimum relative humidity. The study revealed that weather variables significantly influenced the seasonal abundance and fluctuation of major insect pests in tomato. Understanding these pest-weather relationships could facilitate the development of timely forecasting systems and eco-friendly integrated pest management strategies for sustainable tomato production in the Terai region of West Bengal.

Keywords*: Tomato, pests, population dynamics, weather parameters*

Microbiome-Mediated Disease Suppression: Recent Advances in Sustainable Crop Health Management

Tanusree mondal[a*], P M Bhattacharya[a], Hemant Purohit[b]
Mail: tanusree2406@gmail.com
[a]Department of Plant Pathology, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar- 736165
[b]HiMedia labs, Nagpur, Maharashtra- 440008

Abstract

Maize (*Zea mays* L.) cultivation has expanded significantly in eastern India during the rabi season, but its productivity is challenged by biotic and abiotic stresses. Northern Corn Leaf Blight (NCLB), caused by *Exserohilum turcicum*, is a major disease constraint, while variations in moisture, temperature, and nutrient availability further limit crop performance. The growing demand for sustainable production systems has highlighted the potential of biostimulants combined with optimized nutrient management

to improve crop growth, yield, and disease resistance. A field experiment was conducted to evaluate the effects of HI Media SR-HPP-P3 and DPV biostimulants in combination with 0%, 75%, and 100% recommended doses of fertilizer (RDF). Treatments receiving biostimulants with 75% and 100% RDF significantly enhanced plant growth, physiological performance, and yield. The highest plant height (210 cm) and biomass accumulation (194.43 kg) were recorded with HI Media SR-HPP-P3 + 100% RDF, while the maximum grain yield (129.09 kg) was obtained with DPV + 100% RDF. Biostimulant-treated plants also exhibited higher SPAD values and lower Area Under Disease Progress Curve (AUDPC) values, indicating improved chlorophyll content and reduced disease severity. Metagenomic analysis revealed notable changes in the rhizosphere microbial community. Beneficial microorganisms, including *Priestia* spp., *Bacillus* spp., *Rhizobium* spp., and nitrifying bacteria, were enriched in biostimulant-treated soils. In contrast, *Burkholderia* spp. were more abundant under 0% RDF treatments, suggesting distinct microbial responses to nutrient availability. Overall, the integration of biostimulants with fertilizers improved plant growth, productivity, and disease suppression while promoting a beneficial rhizosphere microbiome. These findings indicate that biostimulant-based nutrient management can serve as a sustainable strategy for enhancing maize productivity, particularly under nutrient-stressed conditions.

Keywords*: Biostimulants, NCLB, Disease suppression, Metagenomics, Rhizosphere microbiome, Sustainable*

Evaluation of different black pepper varieties grown as mixed crop in arecanut (*cv.* Mohitnagar) based cropping system for growth, yield and quality under *Terai* Region of West Bengal

Tuhin Samanta[1] and Partha Sarathi Medda[2]

[1]Department of Plantation Crops and Processing, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar 736165, West Bengal, India

****Corresponding author e-mail: samantatuhin1996@gmail.com***

Abstract

A field experiment was conducted at the Instructional farm, Uttar Banga Krishi Viswavidyalaya, Pundibari, West Bengal during 2023 to 2025 for evaluation of different black pepper varieties grown as mixed crop in arecanut plantation (*cv.* Mohitnagar) for growth, yield and quality under *terai* region of West Bengal. The main objective was to evaluate suitable *cv.* of black pepper (*Piper nigrum* L.) for *terai* region of West Bengal. Five different black pepper varieties such as, Panniyur-1, Panniyur-2, Panniyur-5, Panniyur-6 and Sreekara were grown in three replications for evaluating their growth parameters, yield, and quality attributes at four years age. In terms of spike peduncle length (2.66 cm), Spike length (11.73 cm), Well developed Berries (41.96) Panniyur-6 registered best performance followed by Sreekara, whereas, the lowest was recorded in Panniyur-2. Green berry yield of two years mean indicated significantly higher yield in Panniyur-6 (434.45 g/vine) followed by Panniyur-1 (322.48 g/vine) and Panniyur-2 (234.87 g/vine) and differed significantly over other varieties. Among the quality parameters, Panniyur-1 recorded maximum essential oil (3.17%) and piperine content (4.1%) and Panniyur-2 had maximum oleoresin content (11%).

Keywords*: Varieties, Yield, Quality and Black pepper.*

Development of a Lemongrass Oil-Based Dual-Insecticide Microemulsion with Improved Efficacy and Safety

Nusrat Iqbal[1], Dipak Kumar Hazra[2], Soumyadeep Mandal[2*], Rajib Karmakar[2], Sunil Kumar Ghosh[4], Mahesh Kumar Saini[3], Chetan Jawale[1], Samsul Alam[1], Shubham Yadav[1], Amrish Agrawal[1], Jitendra Kumar[1]

[1]Formulation Division, Institute of Pesticide Formulation Technology (IPFT), Sec-20, Udhyog Vihar, Gurugram-122016, India

[2]All India Network Project on Pesticide Residues & Contaminants, Department of Agricultural Chemicals, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia-741252, West Bengal, India

[3]Pesticide Management Division, National Institute of Plant Health Management (NIPHM), Rajendranagar, Hyderabad - 500 030 (Telangana) India

[4]Department of Agricultural Entomology, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia-741252, West Bengal, India

[*]***Corresponding author e-mail: soumya9802@gmail.com***

Abstract

The development of synergistic multi-component insecticide formulations offers a promising strategy for effective pest management while minimizing risks to humans and non-target organisms. In the present study, a lemongrass oil-based microemulsion (ME) system containing acetamiprid (ACP) and chlorpyrifos (CCP) was successfully developed to enhance insecticidal efficacy and environmental safety. The formulated ME was characterized using advanced analytical techniques, including Fourier Transform Infrared Spectroscopy (FTIR) and High-Performance Liquid Chromatography (HPLC), and evaluated for its physicochemical properties, storage stability, biological efficacy, and safety to non-target organisms. The optimized microemulsion exhibited desirable characteristics, including low surface tension (40–45 dynes/cm), reduced contact angle (20-30°), pH ranging from 5 to 7, viscosity of 19-28 cP, and nanosized droplets (30-40 nm). The formulation demonstrated excellent storage stability, showing minimal deterioration (d"10%) under temperature fluctuations ranging from 0 to 54°C. The small droplet size and enhanced surface area contributed to superior foliar spreading, coverage, and deposition, resulting in reduced pesticide loss and prolonged field persistence. Bioassay studies revealed that the ME formulation achieved approximately 90% control of mustard insect pests even at half of the recommended dose, indicating a synergistic effect between ACP and CCP. Furthermore, toxicological assessments on beneficial non-target organisms demonstrated improved safety of the ME formulation toward important predatory species, including *Cheilomenes sexmaculata* and *Amblyseius ovalis*, compared with conventional formulations. Overall, the lemongrass oil-stabilized acetamiprid chlorpyrifos microemulsion represents an innovative, stable, and eco-friendly formulation with enhanced efficacy and reduced ecological risk, offering a sustainable approach for integrated pest management in mustard cultivation.

Keywords: *Microemulsion, Acetamiprid, Chlorpyrifos, Lemongrass oil, FTIR, Synergistic Insecticidal Activity.*

Monitoring and Assessment of Multi-class Pesticide Residues in Fresh and Processed Leaf of *Moringa oleifera* by Ultra Performance Liquid Chromatography- Tandem Mass Spectrometry (UPLC–MS/MS)

Utkrist Gurung, Narayan Bhowmick, Sankhajit Roy and Ramen Kumar Kole*
Department of Agricultural Chemicals, Bidhan Chandra Krishi Viswavidyalaya
Mohanpur, Dist. – Nadia, West Bengal - 741252
Email: ukkugurung@gmail.com
Corresponding author email: kole.ramen.kr@bckv.edu.in

Abstract

Moringa oleifera Lam., widely known as the "miracle tree", is increasingly consumed worldwide due to its exceptional nutritional and medicinal properties. The growing commercial demand for Moringa leaves and derived products has intensified cultivation practices, potentially leading to the application of chemical pesticides. Since Moringa leaves are often consumed fresh or minimally processed, the presence of pesticide residues may pose significant food safety concerns. The present study aimed to monitor the occurrence of multi-pesticide residues in fresh *Moringa oleifera* leaves collected from different districts of West Bengal, India and commercially processed Moringa leaf powder samples of different brands purchased through online retail platforms, using a validated UPLC–MS/MS analytical method. Sample extraction was performed using a modified QuEChERS method followed by dispersive solid phase extraction cleanup. Chromatographic separation and quantification were carried out using UPLC coupled with a triple quadrupole mass spectrometer operating in multiple reaction monitoring mode. The analytical method demonstrated excellent linearity ($R^2 = 0.993 - 0.999$), satisfactory recoveries (77.4 - 111.6%), and acceptable precision with limits of quantification of 10 µg kg{ ¹. Monitoring results revealed low occurrence of pesticide residues in the analyzed samples. Carbofuran was detected in fresh leaf samples from Nadia and North 24-Parganas districts, with one sample exceeding the default maximum residue limit of 0.01 mg kg{ ¹. Among the commercial Moringa powder products, carbofuran and carbendazim were detected in two samples at levels within permissible limits. The study demonstrates the effectiveness of the validated LC-MS/MS method for pesticide residue surveillance in Moringa products and highlights the need for continued monitoring and crop specific regulatory standards.

Keywords: *Moringa oleifera; Pesticide residues; UPLC-MS/MS; QuEChERS; Multi-pesticide residue analysis; Food safety.*

Metabolite profiling of tuberose cultivars for identification and quantification of volatile compounds

Vardhelli Soukya*[1]
[1]Ph.D. Scholar, Department of Floriculture, Medicinal and Aromatic Plants, Faculty of Horticulture, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal – 736165,
Email: soukyarao.v@gmail.com

Abstract

Tuberose (*Polianthes tuberosa* L.) is one of the most important tropical ornamental bulbous flowering plants valued for cut flower, loose flower and perfumery industry. Several volatile compounds are responsible for the characteristic sweet fragrance of this crop. These volatile compounds are associated with important biological activities, like - antimicrobial, anti-inflammatory, antioxidant and aromatic

properties. To assess the source of the characteristic fragrance of tuberose - this experiment was conducted. The experiment was carried out at the Instructional Farm of the Department of Floriculture, Medicinal and Aromatic Plants, Faculty of Horticulture, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal from May 2024 following Randomized Block Design with 24 genotypes which were replicated thrice. Different volatile compounds are reported from twenty four genotypes of tuberose among which benzyl alcohol was identified in **eight** genotypes namely BR-17, BR-2, BR-20, Calcutta Double, Pearl Double, Suvasini, Swarna Rekha and Vaibhav indicating it as the most widely distributed volatile compound. Methyl anthranilate was recorded in **six** genotypes including Arka Sugandhi, BR-20, Mexican Single, Pearl Double, Phule Rajani and Swarna Rekha. Methyl salicylate was observed in **five** varieties such as Arka Sugandhi, BR-1, BR-2, BR-20 and Phule Rajani. Indole was present in **three** genotypes namely BR-20, Pearl Double and Vaibhav, while methyl benzoate was detected in **two** genotypes i.e., BR-2 and Calcutta Double. Similarly, benzyl benzoate was identified as prominent volatile compound in **two** genotypes namely BR-18 and Suvasini.

Keywords: *Tuberose, volatile compounds, benzyl alcohol, methyl anthranilate, floral fragrance and genotypes.*

Bioefficacy assessment of BIL 324 (Fungicide–Insecticide Mixture) against major Tomato Pests and Early Blight during kharif season in Cooch Behar, West Bengal

Arindam Das[1], Pardeep[1], Devika J[1], Abhisa Bhandari[*,1], Surajit Khalko[2] and Nilanjana Choudhury[3]

[1]Department of Vegetable and Spice Crops, [2]Plant Pathology, [3]Agricultural Entomology

****Corresponding author e-mail: abhishabhandari@gmail.com***

Abstract

Tomato is one of the most important vegetable crops cultivated in India; however, its productivity is severely constrained by major insect pests such as whitefly, thrips, and fruit borer, along with early blight disease caused by *Alternaria solani*. A field experiment was conducted during Kharif 2025 at the Instructional Farm, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal, to evaluate the bioefficacy of BIL 324, a novel fungicide–insecticide mixture, against major tomato pests and diseases. The experiment was laid out in a Randomized Block Design with three replications using tomato hybrid 'Abhimanyu'. Different doses of BIL 324 (1000, 1250 and 1500 ml ha{ ¹) were compared with standard insecticidal, fungicidal and tank-mix treatments. Three foliar applications were imposed at 15-day intervals following attainment of economic threshold levels. The results revealed that BIL 324 at 1250 and 1500 ml ha{ ¹ significantly suppressed whitefly and thrips populations throughout the crop season. The highest dose (1500 ml ha{ ¹) recorded up to 84.91% reduction in whitefly and 92.13% reduction in thrips over the untreated control. Fruit borer infestation was also effectively managed, with maximum reduction of 85.81% observed at 1500 ml ha{ ¹. The formulation exhibited excellent efficacy against early blight, recording 78.25% disease reduction and maintaining the lowest disease severity. Enhanced pest and disease management resulted in higher fruit yield, with BIL 324 at 1500 ml ha{ ¹ producing 25.13 t ha{ ¹ and a 45.24% yield increase over the untreated control. The treatment also registered the highest benefit:cost ratio (2.66). Furthermore, BIL 324 showed no phytotoxic effects even at elevated doses and did not adversely affect coccinellid predator populations. The study demonstrated that BIL 324 is an effective, economically viable and environmentally compatible option

for integrated pest and disease management in tomato.

Keywords: *Tomato, Fungicide-insecticide mixture, Whitefly, Thrips, Early blight, Integrated pest management.*

Soil Acidification, Aluminium Speciation and Nutrient Dynamics under Tea (*Camellia sinensis* L.) Plantations of Contrasting Ages in an Emerging Tea-Growing Region of Eastern Bihar

Annu Sinha[1], S.C. Paul[2] and Adyant Kumar[3]

[1]Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, West Bengal, India

[2]Dr. Kalam Agricultural College, Bihar Agricultural University, Kishanganj, Bihar, India

Abstract

Tea (*Camellia sinensis* L.) is a globally important plantation crop that thrives under acidic soil conditions. However, prolonged tea cultivation can intensify soil acidification, alter aluminium dynamics, and influence nutrient availability, thereby affecting soil health and long-term productivity. Information regarding age-related changes in soil acidity and aluminium fractions in emerging tea-growing regions of eastern Bihar remains scarce. Therefore, the present investigation was conducted in tea plantations of different ages in Kishanganj district of Bihar to evaluate soil physicochemical properties, forms of soil acidity, aluminium fractions, and nutrient dynamics. The present investigation was conducted to:**(i)** Quantify age-dependent variations in active and reserve acidity fractions in tea plantation soils.**(ii)** Assess aluminium speciation and its contribution to soil acidification under contrasting plantation ages.**(iii)** Elucidate the relationships among soil acidity parameters, aluminium fractions, physicochemical properties, and nutrient dynamics in tea agroecosystems. Surface soil samples collected from tea plantations representing different age groups were analyzed using standard analytical procedures. Surface soil samples (0–30 cm) were collected from tea plantations representing five age groups (<10, 10–20, 20–30, 30–40 and >40 years). Soil pH, electrical conductivity, cation exchange capacity, organic carbon, available nutrients, forms of soil acidity, and aluminium fractions were determined using standard analytical procedures. Statistical analyses including Pearson correlation and regression models were employed to elucidate relationships among soil properties, acidity parameters, and nutrient dynamics. Soil acidity was partitioned into hydrolytic, exchangeable, extractable, non-exchangeable, pH-dependent and total potential acidity fractions. Aluminium was fractionated into exchangeable, extractable, non-exchangeable, oxalate-extractable and free oxide forms. Correlation and regression analyses were employed to elucidate relationships among soil properties, acidity indices, aluminium fractions and nutrient availability. The investigated soils were predominantly sandy loam to sandy clay loam in texture, with sand constituting the dominant particle fraction, resulting in comparatively low water-holding capacity. Soil reaction varied from strongly to moderately acidic, with pH values ranging from 4.65 to 5.48, and a progressive decline in pH was observed with increasing plantation age. Electrical conductivity and cation exchange capacity were generally low, whereas soil organic carbon content remained relatively high across all plantation age groups. Free Fe oxides and oxalate-extractable Fe ranged from 0.54–0.60% and 0.69–0.75%, respectively. All acidity fractions exhibited significant positive interrelationships, indicating a close association among active and reserve acidity pools. Older tea plantations accumulated greater amounts of hydrolytic, exchangeable, extractable, non-exchangeable and pH-dependent acidity than younger plantations. Among the acidity components, pH-dependent acidity constituted the dominant

fraction, accounting for 90.84% of total potential acidity, followed by extractable acidity (6.25%), exchangeable acidity (6.20%), non-exchangeable acidity (1.98%) and hydrolytic acidity (1.77%), highlighting the predominance of reserve acidity in tea-growing soils. Aluminium fractionation revealed a progressive increase in aluminium accumulation with plantation age. Exchangeable, extractable, non-exchangeable, oxalate-extractable and free aluminium oxide fractions varied from 1.13–1.86, 0.85–1.42, 0.13–0.83 meq 100 g{ ¹, 0.39–0.49%, and 0.27–0.33%, respectively. . Strong positive relationships were observed between aluminium fractions and soil acidity parameters. Regression modelling identified exchangeable aluminium as the dominant regulator of soil acidity dynamics, explaining up to 72% of the variability in pH-dependent acidity and total potential acidity across tea plantations of different ages. Strong positive relationships between aluminium fractions and soil acidity parameters suggest that aluminium mobilisation is a major driver of acidification processes in long-term tea cultivation. Macronutrient dynamics were markedly influenced by soil acidity and aluminium behaviour. Exchangeable NH,, z –N, NO*f* { –N, available phosphorus, potassium and sulphur ranged from 8.55–10.76 mg kg{ ¹, 7.55–8.84 mg kg{ ¹, 27.31–37.66 kg ha{ ¹, 118.12–127.29 kg ha{ ¹ and 10.28–19.83 mg kg{ ¹, respectively. Total nitrogen, phosphorus and potassium contents varied from 0.11–0.13%, 0.05–0.06% and 1.14–1.27%, respectively. The observed nutrient variability indicates that progressive soil acidification and aluminium enrichment play a crucial role in regulating nutrient availability and fertility status in tea agroecosystems.

The findings demonstrate that plantation age is a critical determinant of soil acidification intensity, aluminium behaviour and nutrient-use efficiency in tea agroecosystems. The study advances the understanding of long-term soil degradation processes in perennial plantation systems under humid subtropical environments and provides a scientific basis for developing integrated acidity amelioration strategies involving site-specific liming, organic matter enrichment and balanced nutrient management to sustain soil health and tea productivity in acid-prone regions. The predominance of pH-dependent acidity and progressive aluminium enrichment under long-term cultivation indicate increasing risks of nutrient imbalance and soil quality deterioration. These findings provide new insights into acid soil processes in tea-growing ecosystems and support the development of site-specific liming and nutrient management strategies for sustainable tea production.

Keywords: *Soil acidification, Aluminium fractionation, pH-dependent acidity, Exchangeable aluminium, Nutrient dynamics, Tea agroecosystem, Soil fertility, Sustainable tea cultivation.*

Evidence-Based Integrated Farming Systems for Income Enhancement and Sustainable Livelihoods in West Bengal

Avijit Haldar[1,*], Satyendra Nath Mandal[2], Prasenjit Pal[3], Upama Das[1], Ayan Das[2], Kunal Roy[2], Arkaprabha Shee[4], Biswajit Goswami[5], Dhiman Mahato[6], Dipankar Ghorai[7], Kaushik Pal[8], Madhuchhanda Khan[9], Malay Kumar Samanta[10], Manas Kumar Das[11], Moumita Dey Gupta[12], Moutusi Dey[13], Pranab Barma[14], Prasanta Chatterjee[15], Rahul Deb Mukherjee[16], Rakesh Roy[17], Srabani Das[18], Swagat Ghosh[19], Prabhat Kumar Pal[20]

****Corresponding author email: vetavijit@gmail.com, Mobile: 8017325546***

Address: ICAR-Agricultural Technology Application Research Institute Kolkata, Indian Council of Agricultural Research, Kolkata- 700097, West Bengal, India

[1]ICAR-Agricultural Technology Application Research Institute Kolkata, Sector III, Salt Lake, Kolkata- 700097, West Bengal, India
[2]Department of Information Technology, Kalyani Government Engineering College, Kalyani, Nadia- 741235, West Bengal, India
[3]ICAR-Central Institute of Fisheries Education, Indian Council of Agricultural Research, Andheri (West), Mumbai 400061, Maharashtra, India
[4]Dhaanyaganga Krishi Vigyan Kendra, Ramakrishna Mission Ashrama, Sargachhi Ashrama, Sargachhi, Murshidabad-742408, West Bengal, India
[5]Dakshin Dinajpur Krishi Vigyan Kendra, Uttar Banga Krishi Viswavidyalaya, Majhian, Patiram, Dakshin Dinajpur-733133, West Bengal, India
[6]Kalyan Krishi Vigyan Kendra, Jahajpur, Biltora, Purulia- 723126, West Bengal, India
[7]Burdwan Krishi Vigyan Kendra, ICAR- Central Research Institute for Jute & Allied Fibres, Bud Bud, Purba Bardhaman- 713403, West Bengal, India
[8]North 24 Parganas Krishi Vigyan Kendra, West Bengal University of Animal and Fishery Sciences, Ashokenagar, North 24 Parganas- 743222, West Bengal, India
[9]Rathindra Krishi Vigyan Kendra, Palli Siksha Bhavana, Institute of Agriculture, Viswa Bharati, Sriniketan, Birbhum- 731236, West Bengal, India
[10]Nadia Krishi Vigyan Kendra, Bidhan Chandra Krishi Viswavidyalaya, Gayeshpur, Nadia- 741234, West Bengal, India
[11]Jalpiguri Krishi Vigyan Kendra, West Bengal University of Animal and Fishery Sciences, Ramshai, Jalpaiguri-735 219, West Bengal, India
[12]Bankura Krishi Vigyan Kendra, West Bengal Comprehensive Area Development Corporation, Sonmukhi, Bankura- 722207, West Bengal, India
[13]Uttar Dinajpur Krishi Vigyan Kendra, Uttar Banga Krishi Viswavidyalaya, Chopra, Uttar Dinajpur-733207, West Bengal, India
[14]Darjeeling Krishi Vigyan Kendra, Uttar Banga Krishi Viswavidyalaya, Kalimpong- 734301, West Bengal, India
[15]Nimpith Krishi Vigyan Kendra, Nimpith, South 24 Parganas- 743338, West Bengal, India
[16]Coochbehar Krishi Vigyan Kendra, Uttar Banga Krishi Viswavidyalaya, Pundibari, Coochbehar-736165, West Bengal, India
[17]Malda Krishi Vigyan Kendra, Uttar Banga Krishi Viswavidyalaya, **Ratua, Malda- 732205,** West Bengal, India
[18]Jhargram Krishi Vigyan Kendra, Bidhan Chandra Krishi Viswavidyalaya, Regional Research Station, *Jhargram* – 721 507, West Bengal, India
[19]Sasya Shyamala Krishi Vigyan Kendra, Ramakrishna Mission Vivekananda Educational and Research Institute, Arapanch, Sonarpur, South 24 Parganas-700150, West Bengal, India
[20]Director of Extension Education, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar 736165, West Bengal, India

Abstract

The present study aimed exploring technically feasible, economically viable, area-specific model integrated farming system (IFS) in view of scaling up the adoption of IFSs in six agro-climatic zones (ACZs) of West Bengal, a state of Eastern India. Multi-stage sampling was followed to select IFS adopted farmers (n~60) as respondents. Farm-level data on 211 independent variables under 20 dependent

variables were collected through field observations and face-to-face interviews using a pre-structured, interactive, and user-friendly questionnaire comprising both quantitative and qualitative components. This study identified and ranked key factors, based on relative closeness values (ranging from 0 to 1), influencing IFS adoption in West Bengal through a SWOC (Strengths, Weaknesses, Opportunities, and Challenges)– TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution) analysis, a robust multi-criteria decision-making (MCDM) method grounded in machine learning principles. Zone-specific insights revealed strength, opportunity, weakness and challenge factors for developing IFSs. To the best of our knowledge, a smart, intelligent, user-friendly, digital data entry form with real-time scoring facility was developed for the first-time to evaluate and rank IFSs. Each IFS's total score determined its rank within its ACZ and across the state. Based on the highest net income from a particular component, horticulture-based systems were the most prevalent (35.0%), followed by livestock-based (25.0%), fishery-based (21.7%), and agriculture-based systems (18.3%). The resulting database supported the development of a software template of model IFSs, including area development bankable plans for six ACZs in West Bengal (Copyright Reg. No. SW-19646/2024 dated 21/11/2024). This study proposes a farmer-centric, evidence-based, resilient, sustainable and economically viable, replicable IFS model for contextual planning and informed decision-making in West Bengal and similar agro-climatic regions across India and beyond.

Keywords*: Integrated farming systems; Diverse Agro-Climatic Zones, West Bengal, Multi-criteria decision-making; Digital Data Entry Form, Evidence-Based Software Template*

Building Resilience through Indigenous and Local Knowledge: Lessons from Farming Communities Facing Climate Change

Ayanavo Dey[a], Deepa Roy[b]

[a]Research Scholar, Department of Agricultural Extension, Uttar Banga Krishi Viswavidyalaya

[b]Assistant Professor, Department of Agricultural Extension, Uttar Banga Krishi Viswavidyalaya

Corresponding author's mail: ayanavodey28@gmail.com

Abstract

Climate change is creating serious challenges for farming communities through irregular rainfall, droughts, floods, rising temperatures, and declining crop productivity. Indigenous and Local Knowledge (ILK) refers to the traditional knowledge, skills, and practices that farming communities have developed over generations through their close relationship with nature. This knowledge plays an important role in helping farmers adapt to climate change and build resilience. Many indigenous practices are still used by farmers today. These include rainwater harvesting through traditional ponds and tanks, growing drought-tolerant local crop varieties, mixed cropping and crop rotation, mulching to conserve soil moisture, agroforestry systems, and using natural signs such as bird migration, flowering patterns, insect behaviour, and cloud movements to predict weather changes. For example, some farmers observe the early flowering or increased ant activity as indicators of upcoming rainfall. These traditional practices are often low-cost, environmentally friendly, and suited to local conditions. When combined with modern scientific knowledge and agricultural innovations, they can improve farmers' ability to cope with climate-related risks, enhance food security, conserve biodiversity, and support sustainable agriculture. However, indigenous knowledge is gradually declining due to modernization, urbanization, and inadequate documentation. This paper highlights the importance of preserving and promoting indigenous knowledge

through community participation, agricultural extension services, and supportive policies. Integrating local wisdom with scientific approaches can help create effective and sustainable pathways for building climate-resilient farming communities in the face of changing environmental conditions.

Keywords: *Indigenous and Local Knowledge, Climate change, Resilience, Farming community, Adaptive strategies*

Climate Change and Coastal Livelihoods: Perceived Impacts, Vulnerability Assessment, and Adaptation Strategies of Fishers in Kanniyakumari District, Tamil Nadu

Biswarup Saha[1]* and Vishmaya J[2]

[1]Professor, Department of Fishery Extension, Faculty of Fishery Sciences, West Bengal University of Animal and Fishery Sciences (WBUAFS), Kolkata

[2]M.F.Sc. Scholar, Department of Fishery Extension, Faculty of Fishery Sciences, West Bengal University of Animal and Fishery Sciences (WBUAFS), Kolkata

Corresponding author e-mail- biswarup.ext@gmail.com

Abstract

Climate change has emerged as a major threat to coastal fisheries, affecting fish availability, fisher livelihoods, and the sustainability of marine ecosystems. This study assessed the perceived impacts of climate change, household vulnerability, and adaptation strategies among fishing communities in the coastal fisheries of Kanniyakumari district, Tamil Nadu. A descriptive and diagnostic research design was adopted, and primary data were collected from 120 fisher households across four coastal villages through personal interviews and focus group discussions. Three composite indices were developed, namely the Perceived Impact of Climate Change Index (PICCI), Household Vulnerability to Climate Change Index (HVCCI), and Climate Change Adaptive Response Index (CCARI), to evaluate climate change impacts, vulnerability levels, and adaptation responses. Data were analyzed using descriptive statistics, Principal Component Analysis (PCA), and regression analysis. The findings revealed that climate change has significantly affected the socio-economic and environmental conditions of fishing communities. About 80.03% of fishers experienced high economic impacts, while nearly 92% reported declining fish catches and reduced income over time. Environmental impacts were perceived as severe by 94.16% of respondents, with 95.83% reporting reduced fish diversity and offshore migration of fish stocks due to rising sea surface temperatures and increased frequency of extreme weather events. Fisheries constituted an average of 90.25% of total household income, indicating a high dependence on marine resources. Vulnerability assessment showed that 24.16% of households were very highly vulnerable to climate change, primarily due to low adaptive capacity and excessive reliance on fisheries-based livelihoods. Fishers adopted several adaptation measures, including compliance with seasonal fishing bans (CCARI = 1.00), use of improved fishing gear (CCARI = 1.00), reliance on early warning systems (CCARI = 1.00), and adjustment of fishing schedules during adverse weather conditions (CCARI = 0.92). The study highlights the need for targeted policy interventions focused on livelihood diversification, strengthening adaptive capacity, and promoting community-based climate adaptation strategies to enhance resilience and ensure the long-term sustainability of coastal fisheries in Kanniyakumari district.

Keywords: *Climate Change Impacts, Coastal Fisheries, Vulnerability Assessmen, Adaptive Response, Fishing Households, Principal Component Analysis (PCA).*

Biochemical Characterization, and Antagonistic Evaluation of Native Plant Growth-Promoting Bacteria for Bioinoculant Development in Tissue-Cultured Plantlets of Teak and Bamboo

Darshan K*, Saurabh Dubey, S N Mishra, AJK Asaiya and Avinash Jain
[1]ICFRE- Tropical Forest Research Institute, Jabalpur, Madhya Pradesh -482021
Presenting author Email ID: darshank@icfre.org

Abstract

The successful establishment of tissue-cultured teak and bamboo plantlets under nursery and field conditions is often constrained by diseases, transplant shock, and poor acclimatization. To overcome these challenges, nature-based solutions involving native plant growth-promoting bacteria (PGPB) offer a promising biological approach for enhancing plant health and productivity during the critical hardening phase. In the present study, a total of 450 bacterial isolates were obtained and subjected to primary screening for the selection of the elite strains. Based on their antagonistic and plant growth-promoting potential, 30 elite bacterial isolates were selected based on antagonistic and plant growth-promoting potential were subjected to detailed biochemical and functional characterization. The isolates were evaluated for catalase activity, citrate utilization, ammonia, siderophore, IAA, hydrogen cyanide production, and extracellular enzyme secretion, including EPS, cellulase, protease, and lipase. Out of this, 10 isolates exhibited significant antagonism, demonstrating 50–80% inhibition against soil borne fungal pathogens *Fusarium* sp, 45-75% and also showed 50–72% against foliar pathogens *Alternaria* sp and *Helminthosporium* sp. These isolates also showed strong PGP features, such as the ability to dissolve phosphate (up to 310 µg mL{ ¹), potassium, and zinc, as well as the ability to make IAA and NH_4 (16–50 µg mL{ ¹). Compatibility testing among selected isolates revealed the possibility of developing microbial consortia with complementary plant growth-promoting and biocontrol functions. The top-performing bacterial strains will be utilized for the biotization of micropropagated teak and bamboo plantlets to enhance growth, improve acclimatization, and increase resistance to nursery pathogens. The developed bioinoculants are expected to support sustainable and environmentally safe nursery management practices and contribute to the success of large-scale forestry plantation programs.

Keywords: *Plant growth-promoting bacteria, Biohardening, Tissue-cultured plantlets, Teak, Bamboo, Sustainable forestry.*

Integrated Breeding Strategies in Chilli (*Capsicum annuum* L.) for Yield and Disease Resistance

Dr. Arindam Das
Assistant Professor, Department of Vegetable and Spice Crops, Faculty of Horticulture, Uttar Banga Krishi Viswavidyalaya,
Pundibari, CoochBehar, West Bengal, Pin-736165, India
E-mail: arindamdas@ubkv.ac.in

Abstract

Chilli (*Capsicum annuum* L.) is an economically important spice and vegetable crop where enhancement of yield and resistance to Chilli Veinal Mottle Virus (*ChiVMV*) remain major breeding objectives. The present investigation integrated germplasm characterization, genetic diversity analysis, parent selection, hybridization, and Fevaluation to develop superior chilli genotypes. Initially, fifty-seven diverse chilli genotypes collected from different parts of India were evaluated during 2021-22 in a randomized block

design to assess variability, diversity, yield attributes, and resistance to *ChiVMV*. Significant variability was observed for all studied traits, indicating the presence of substantial genetic diversity. High phenotypic and genotypic coefficients of variation, heritability, and genetic advance were recorded for fruit yield per plant, yield per hectare, and fruit weight, suggesting the predominance of additive gene effects and the effectiveness of direct selection. Multivariate analyses revealed considerable genetic divergence among genotypes, grouping them into ten distinct clusters. Nineteen genotypes were identified as immune, one as resistant, and four as moderately resistant to *ChiVMV*, providing valuable sources for resistance breeding. Based on the diversity and disease-resistance studies, selected parental lines were utilized in a line × tester mating design involving five lines and three testers to generate fifteen F hybrids during 2023–25. Combining ability analysis revealed that UBC 3, UBC 11, UBC 19, UBC 6, and UBC 15 were good general combiners for yield and *ChiVMV* resistance. Specific combining ability studies identified UBC 4 × UBC 15, UBC 16 × UBC 10, UBC 11 × UBC 10, and UBC 19 × UBC 6 as superior cross combinations. Significant heterotic responses for fruit yield and disease resistance were observed, with UBC 19 × UBC 6, UBC 3 × UBC 15, UBC 11 × UBC 10, and UBC 11 × UBC 6 emerging as promising hybrids. Gene action studies indicated the predominance of non-additive effects for most traits, highlighting the scope for heterosis breeding. The study demonstrates that integration of genetic diversity assessment with combining ability and heterosis analyses is an effective strategy for developing high-yielding and *ChiVMV*-resistant chilli hybrids, thereby contributing to sustainable chilli improvement programmes.

Key words: *Capsicum annuum, Genetic Diversity, Combining Ability, Heterosis, ChiVMV Resistance, Hybrid Breeding & Yield Improvement.*

Indigenous seed systems as pillars of food security, sowing sovereignty, biocultural heritage and agroecological resilience

Dr. Manas Kumar Pandit
Professor, Department of Vegetable Science, Bidhan Chandra Krishi Viswavidyalay, Mohanpur, Nadia, West Bengal, PIN-741252
E-mail: mkumarpandit@yahoo.com

Abstract

Indigenous seeds, variously known as landraces, farmer-saved, traditional, or heirloom seeds, constitute the biological and cultural foundation of local food systems, developed over centuries of co-evolution between ecosystems and farming communities, serving as a critical Biocultural Heritage for global agriculture and conserved through farmer selection, exchange, and adaptation, embodying Traditional Ecological Knowledge proliferating unique genetic diversity. Since 1900, approximately 75% of global plant genetic diversity has been lost due to the expansion of industrial agriculture, which prioritizes a yield-centric model reliant on genetically uniform cultivars and synthetic inputs. This genetic erosion leaves agricultural systems highly vulnerable to climate change and ecological shocks, disproportionately impacting marginalized groups like smallholders, rural women, and indigenous communities. True sustainability demands moving past restrictive intellectual property regimes and centralized, high-input farming models toward frameworks that embrace seed sovereignty, commons-based governance, and genuine gender justice. Indigenous seed systems thus codify knowledge and culture signifying human connection to nature, embedding spiritual values within agricultural practice that distinguish them from

Western conservation models. Heterogeneous, resilient, open-pollinated landraces, commons-based, low-input, regenerative agroecological practices can provide food and livelihood security through seed sovereignty and local food systems. Supporting and advocating for indigenous seed sovereignty creates more just and sustainable agricultural systems for all.

Keywords*: Indigenous seed systems, seed sovereignty, food security, biocultural heritage, agroecological resilience.*

Comparative Evaluation of Natural Farming and Conventional Farming Systems through diversified crop cultivation in Cooch Behar District

Dr. Sandip Hembram, Dr. Samima Sultana*, Dr. Sankar Saha, Dr. Suraj Sarkar Dr. R Mukherjee, Prof. P. K Paul and Dr. A. Halder,
Cooch Behar Krishi Vigyan Kendra, UBKV and ICAR-ATARI, Kolkata
Corresponding author mail Id: samima.ubkv@gmail.com

Abstract

This study presents a comprehensive comparative analysis of Natural Farming (NF) and Conventional Farming (CF) systems, assessing crop yield, cost of cultivation, gross and net returns, benefit-to-cost (B:C) ratios, and soil health dynamics across three cropping seasons in three different villages of Cooch Behar District during the year of 2024-2025 and 2025-26. Economic analysis revealed that natural farming reduced the cost of cultivation while maintaining comparable yields with conventional farming. Under natural farming, higher benefit-cost (B:C) ratios were recorded in several crops, including pre-kharif tomato (2.54), maize (2.45), leafy vegetables (2.17), and rice (1.79). Net returns were also substantially higher in crops such as tomato, brinjal, okra, and broccoli due to lower external input costs and improved market value of produce. In comparison, conventional farming recorded relatively lower B:C ratios in cabbage (1.39), cauliflower (1.34), and rice (1.73). Under the Natural Farming system, pre-Kharif crops such as maize (B:C 2.45), tomato (B:C 2.54), and okra (B:C 1.99) emerged as highly profitable. Soil health monitoring across five farmer fields revealed overall improvement in pH, available nitrogen, phosphorus, and potassium following the cropping cycle, affirming the soil-restorative potential of Natural Farming practices. The research findings advocate for the inclusion of Natural Farming principles in smallholder crop management strategies as a means of enhancing profitability while promoting soil ecological integrity.

Keywords: *Natural farming, conventional farming, B:C ratio, net return, soil health, Rabi, Kharif, vegetable crops, rice, maize, organic carbon*

Identification of Heat-Resilient Bread Wheat Genotypes Under Terminal Heat Stress

Sunishtha Mishra[1], Girish Chandra Pandey[1*]
[1]Dept. of Bioscience and Biotechnology, Banasthali Vidyapith, Rajasthan, India
girishchandrapandey@banasthali.in

Abstract

Terminal heat stress is a major constraint to wheat production, particularly in regions where elevated temperatures coincide with reproductive and grain-filling stages. The present study aimed to identify heat-resilient bread wheat (*Triticum aestivum* L.) genotypes through integrated field-based phenotyping

under contrasting sowing environments. Ten wheat genotypes were evaluated during two consecutive crop seasons (2023–24 and 2024–25) under timely-sown and late-sown conditions at Banasthali Vidyapith, Rajasthan. Late sowing was used to impose terminal heat stress, exposing plants to increased temperatures during anthesis and grain filling. Phenological, physiological, agronomic, and yield-related traits were assessed to characterize genotypic responses to heat stress. Phenological traits such as days to heading, days to anthesis, and days to physiological maturity exhibited changes under stress conditions. In contrast, grain-filling duration, photosynthetic efficiency measured by chlorophyll content, chlorophyll fluorescence and yield-associated traits showed marked genotypic differences. Heat-resilient genotypes maintained longer grain-filling duration and superior performance under late-sown conditions. Integrated evaluation consistently identified HP1209, DBW316, HD3090, PBW590, and JKW261 as terminal heat resilient genotypes, whereas PBW660 and HI1544 exhibited greater sensitivity to terminal heat stress. The findings demonstrate the effectiveness of integrated field-based phenotyping for identifying heat-resilient wheat genotypes and key adaptive traits associated with stress tolerance. These genotypes represent valuable genetic resources for breeding programmes aimed at developing climate-resilient wheat cultivars capable of maintaining productivity under increasingly warmer environments.

Keywords: *bread wheat, terminal heat stress, field phenotyping, heat resilience, grain filling, yield stability, climate resilience.*

Effect of real time nitrogen management through precision tools under different establishment techniques on growth of rabi maize (*Zea mays* L.)

[1]Jitendra Majji[*] and [2]Partha Sarathi Patra

[1]Research Scholar, Agronomy,

[2]Assistant Professor, Department of Agronomy

Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal-736165

****Correspondence author email: jitendramajji@gmail.com***

Abstract

Maize (*Zea mays* L.), is considered as the "Queen of Cereals" and it is the third most cereal crop after rice and wheat, extensively cultivated for food, animal feed and industrial uses. Nitrogen is one of the key nutrients influencing maize growth. Real time nitrogen management using precision tools like Leaf Colour Chart (LCC) and NDVI tools and Crop establishment techniques play a vital role in determining crop growth through their influence on soil moisture, root development, and nutrient availability. A field experiment was conducted at UBKV in the year of 2025-26 during the rabi season to know the effect of real time nitrogen management through precision tools under different crop establishment techniques on the growth of maize. The field experiment was laid out in a split plot design with flat bed, ridge and furrow and zero tillage as main plot treatments and six nitrogen management practices like control, State recommended dose of fertilizer (S-RDF) @160-80-80 kg ha^{-1}, LCC-based nitrogen application @ 3 and 4 thresholds and NDVI-guided nitrogen application @ threshold values of 0.6 and 0.8 as sub plot treatment. Crop establishment techniques and nitrogen management practices significantly influenced rabi maize growth. Among the crop establishment techniques, Ridge and furrow establishment recorded significantly superior plant height, LAI and dry matter accumulation compared to other two establishment techniques. Among nitrogen management tools, NDVI-guided nitrogen application at threshold 0.8 produced the highest plant height (228.4 cm), LAI (5.08) and dry matter accumulation

(286.5 g plant{ [1]), while the control treatment recorded the lowest . These findings concluded that NDVI-based real time nitrogen management combined with ridge and furrow establishment is an effective approach for enhancing the growth of rabi maize.

Keywords: *Maize, Precision nitrogen management, NDVI, LCC, Growth and Crop establishment techniques*

Pantoea sp.: A microbe ubiquitously present in various micro-ecologies of an Agro-ecosystem

Keerthana B[1], Nilanjana Chaudhuri[2*], Kapudeep Karmakar[2*]

[1]Department of Agricultural Entomology, Uttar Banga Krishi Viswavidyalaya, Coochbehar, India-736165

[2]Regional Research Station Terai Zone, Uttar Banga Krishi Viswavidyalaya, Coochbehar, India-736165

****Corresponding email: drncubkv@gmail.com, kapudeep@ubkv.ac.in***

Abstract

The bacterium *Pantoea* sp. is ubiquitously present in diverse micro ecologies in an agricultural ecosystem viz., soil (dry or submerged), plants (crop as well as weeds), animals (gut of insect, rodent pests, farm animals), irrigation water, etc. All these ecologies have biotic stresses like bacteriophages. Bacteria have developed their innate immune system to counter the attack of invading phages and other mobile genetic elements. Clustered Regularly Interspaced Short Palindromic Repeats (CRISPRs) are DNA elements that impart resistance against bacteriophages. These elements are regulated by Cas (CRISPR associated) genes. Therefore, these CRISPR-Cas cassettes can be used to study the adaptability of the bacteria to various biotic stresses prevailing in environment. This study is focused on the analyses of CRISPR-Cas systems in the genomes of *Pantoea* sp. Using CRISPR Cas++, the genomes of *Pantoea* were assessed for these elements. Among the genomes, only three organisms had annotated CRISPR-Cas elements, they encompassed a large number of spacers. *Pantoea* sp. consists of three types of Cas systems, viz, Type 1E, Type 1F, and Type 1A. Three types of repeat sequences were analyzed and named as GTG, CGG, and TTT types based on the first three nucleotides. The stability of the hairpin loop of the repeat RNA is essential for proper recruitment to target DNA. Thus, its structural stability was also assessed. Though there was no correlation between the number of acquired spacers and the stability of the secondary structure of repeats, some strains with unstable hairpin loop (with nucleotide mismatches) also acquired a large number of spacers, indicating their high resistance towards phages. The phylogenetic analyses showed the inconsistency across all Cas proteins, and they may diversify without relying on the host organism. This study discloses why *Pantoea* withstands the biotic stresses, hinting towards its diverse ecological niches.

Keywords: *Pantoea, CRISPRs, Diversity, Ecology, Repeat*

Assessment of Microbial Diversity in Soils under Different Resource Management Practices in the Terai Zone of West Bengal

Md Shahajahan[1], Ashok Choudhury[2], Abhas Kumar Sinha[3]

[1]Research Scholar, Department of Soil Science & Agricultural Chemistry, UBKV, Pundibari, Coochbehar, WB

[2]Professor, Department of Soil Science & Agricultural Chemistry, UBKV, Pundibari, Coochbehar, WB
[3]Professor & Head Department of Soil Science & Agricultural Chemistry, UBKV, Pundibari,Coochbehar, WB
Corresponding Author: shahajahanmd023@gmail.com

Abstract

This study evaluated the effect of different resource management practices on soil microbial diversity in the Terai region of West Bengal. Rhizospheric soil samples collected from maize fields under conventional and zero tillage systems, with varying residue and fertilizer management, were analyzed using 16S rRNA and ITS-based metagenomic sequencing. Results showed that zero tillage and residue retention enhanced both bacterial and fungal diversity compared to conventional tillage. Conservation agriculture practices promoted beneficial microbial groups involved in nutrient cycling, organic matter decomposition, and plant growth promotion. Higher microbial diversity was positively associated with soil organic carbon, nitrogen, and phosphorus availability, while bulk density showed negative effects. The findings indicate that conservation-based resource management improves soil microbial health, contributing to sustainable soil fertility and agricultural productivity.

Keywords: *bacteria, diversity, soil microbes, fungus*

Comparative Studies on Growth and Yield Parameters of the Black Gram Genotypes Grown Under Kharif and Pre-Kharif Seasons

Mrinal Sahu[1], Dr. Subhasis Mondal[1]
[1]Department of Plant Physiology, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia 741252 West Bengal, India
****Corresponding author email: mini170620@gmail.com***

Abstract

Black gram (*Vigna mungo* L. Hepper) is a nutritionally significant pulse crop of the Indian subcontinent, valued for its protein-rich, high-fibre seeds and ability to fix atmospheric nitrogen. Although traditionally cultivated as kharif crop in West Bengal, weakly photosensitive varieties has enabled its expansion into the pre-kharif season. The present study, "Comparative Studies on Growth and Yield Parameters of the Black Gram Genotypes Grown Under Kharif and Pre-Kharif Seasons," was undertaken to evaluate the physiological growth performance and yield of black gram varieties under two contrasting seasons. Twelve black gram varieties were grown at the In-check Farm of BCKV, Kalyani, Nadia, West Bengal, during both kharif and pre-kharif seasons. Physiological growth indices- Leaf Area Index (LAI), Leaf Area Duration (LAD), Crop Growth Rate (CGR), Relative Growth Rate (RGR), and Net Assimilation Rate (NAR) were studied at 45 and 60 DAS. Yield attributes were recorded, and the influence of physiological growth parameters and meteorological factors on yield were assessed. PU-07 (793.52 kg ha{ ¹) in kharif and PU-31 (627.78 kg ha{ ¹) in pre-kharif were the best yield-performing varieties. Yield and yield attributes mostly declined in the pre-kharif compared to kharif crops. LAI and LAD up to 60 DAS were lower in pre-kharif crops. Although CGR, RGR, and NAR were higher during 15-45 DAS in pre-kharif, they declined sharply during 45-60 DAS, falling below kharif values. Results suggest that harsh pre-kharif weather critically impair growth efficiency and limits yield potential in black gram genotypes.

Keywords: *Black gram, Leaf Area Index, Leaf Area Duration, Relative Growth Rate, Net Assimilation Rate*

Differential Rhizosphere Enzyme Activities and Microbial Populations Across Jute-Paddy-Wheat Crops under Long-Term Fertilizer Management

Nandita Sinha[1]*, Gouranga Kar[2], Bijan Majumdar[2], Sonali Paul Mazumdar[2] and Sanjoy Saha[2]
[1]Indian Agricultural Research Institute, Kolkata Hub, West Bengal-700121, India
[2]Division of Crop production, ICAR- Central Research Institute for Jute and Allied Fibres, Barrackpore, West Bengal-700121, India
****Correspondence: sinhaanandita6@gmail.com***

Abstract

Soil biological activity is a sensitive indicator of ecosystem health, it integrates the effects of crop type, nutrient management and organic matter inputs on microbial functioning. The present study was conducted at the Long-Term Fertilizer Experiment (LTFE) of ICAR-Central Research Institute for Jute and Allied Fibres (CRIJAF), Barrackpore, West Bengal, to compare rhizospheric enzyme activities and microbial populations across jute (*Corchorus olitorius* var. JRO 204), direct-seeded paddy (var. Shatabdi) and wheat (var. Ankur-Kedar) under varying nutrient management treatments (control, 50%, 100%, and 150% NPK, and 100% NPK + FYM @ 5 t ha{ ¹). Rhizosphere soil samples were collected at harvest of each crop and analyzed for DHA, FDA, â-glucosidase, acid and alkaline phosphatase and urease activities, along with culturable populations of bacteria, Azotobacter and phosphate-solubilizing bacteria (PSB). Results revealed that jute consistently exhibited highest enzymatic activities and microbial populations, followed by paddy and wheat. Elevated biological activity under jute was attributed to its acquisitive growth strategy, greater rhizodeposition and continuous leaf shedding, which enhanced labile organic carbon availability in the rhizosphere. The acid phosphatase to alkaline phosphatase (AcP/AlkP) ratio was highest under jute, indicating dominance of biologically mediated phosphorus mineralization. Integrated nutrient management (100% NPK + FYM) further stimulated measured biological parameters by improving microbial habitat quality and organic substrate supply. These findings indicate the importance of crop sequence and organic input management in sustaining biological functions under intensive cropping systems.

Keywords: *Rhizosphere, Microbial Population, enzymatic activity, Long-Term fertilization experiment, Integrated nutrient management, Soil health*

Fodder Maize Cultivar Response to Nitrogen Management

Patel H.K*. Litoriya N.S. Raiyani A.M., S.K. Parmar and Geeta Chaudhary
Main Forage Research Station, Anand Agricultural University
Anand 388110 (Gujarat)
Corresponding author: Patel H.K. email. hirenubi@gmail.com

Abstract

During *kharif* 2022 an experiment on response of levels of nitrogen on fodder maize was carried out at Main Forage Research Station, Anand Agricultural University, Anand-Gujarat under sandy loam soil. There was total seven different fodder maize cultivar (DFH-2, HQPM-28, AFH-7, PFM-13, J-1006,

African tall and COHM-8) and three levels of nitrogen (80,120 and 160 kg N/ha). Nitrogen was applied through urea (fifty percent nitrogen as basal and remaining fifty percent at 30 DAS). Recommended dose of phosphorus (40 kg P_2O_5) applied through single super phosphate. According to experiment result revealed that response of different variety on growth, yield and quality parameter was found significant. Response of different variety and levels on nitrogen on plant population at 15 DAS was found non-significant. Fodder maize variety J-1006 noted significantly higher plant height (276 cm) and number of leaves per plant (15.51) than other fodder maize variety. Green fodder yield of COHM-8 (875 q/ha), dry matter yield (131 q/ha) and crude protein yield (7.77 q/ha) was stand first among all other fodder maize varieties. Response of different nitrogen levels on growth, yield and quality was found significant. The plant population of fodder maize did not show any response to nitrogen application. Application of 160 kg N/ha reported significantly higher plant height (271.33cm) and number of leaves per plant (14.38) at harvest. The maximum green fodder yield (809 q/ha), dry matter yield (127 q/ha) and crude protein yield (7.38 q/ha) was observed in N_3 (160 kg N/ha). It produced a 25.04% higher green fodder yield compared to the lowest nitrogen level (80 kg N/ha). The response of different fodder varieties and nitrogen levels to neutral detergent fiber was found to be non-significant.

Keywords*: Crude protein yield, dry matter yield, fodder maize, green fodder yield and nitrogen*

Nutrient management for productivity enhancement in dual purpose Oat

Patel H.K*. Litoriya N.S., Raiyani A.M., Parmar S.K. and Geeta Chaudhary
Main Forage Research Station, Anand Agricultural University
Anand 388110 (Gujarat)
Corresponding author: Patel H.K. email. hirenubi@gmail.com

Abstract

An experiment on Nutrient management for productivity enhancement in dual purpose oat at Main Forage Research Station, Anand Agricultural University, Anand-388110 Gujarat during 2018-19 to 2020-21 under sandy loam soil of middle Gujarat with major objective to study the effect of nutrient management on yield and quality of dual-purpose oat. Experiment was laid out in Randomized Block Design with three replications and nine integrated nutrient management treatments including zinc application through soil and foliar T_1: Control, T_2: RDF (N: P_2O_5: K_2O = 80:40:40 kg/ha), T_3:75% of RDN + Vermicompost @ 2t/ha, T_4: T_3 + PSB $_{(Soil)}$ @ 1.5 kg/ha, T_5:T4 + Seed treatment with *Azotobactor* @ 10 g/kg seed, T_6:T_5 + $ZnSO_4$ @ 20 kg/ha (soil application as basal), T_7: T_5 + $ZnSO_4$ @ 15 kg/ha (soil application as basal), T_8:T_6 + Foliar spray of $ZnSO_4$ (0.5%) at just before flowering, T_9:T_7 + Foliar spray of $ZnSO_4$ (0.5%) at just before flowering. According to three-year result revealed that, application of 75% of RDN + Vermicompost @ 2t/ha + PSB (Soil) @ 1.5 kg/ha + Seed treatment with *Azotobactor* @ 10 g/kg seed + $ZnSO_4$ @ 20 kg/ha (soil application as basal) *fb* Foliar spray of $ZnSO_4$ (0.5%) at just before flowering reported significantly higher plant height (128.33 and 112.84 cm) at first cut and harvest, respectively and higher number of tiller (101.18) per meter row length. Integrated nutrient management treatment had its significant effect on green fodder yield and quality parameter, application of 75% of RDN + Vermicompost @ 2t/ha + PSB (Soil) @ 1.5 kg/ha + Seed treatment with *Azotobactor* @ 10 g/kg seed + $ZnSO_4$ @ 20 kg/ha (soil application as basal) *fb* Foliar spray of $ZnSO_4$ (0.5%) at just before flowering treatment noted higher green fodder yield (553 q/ha), dry matter yield (69.04 q/ha),

crude protein yield (10.7 q/ha) than rest of treatments. Significantly higher seed (1637 kg/ha) and stover (9124 kg/ha) was reported in treatment T_8 (75% of RDN + Vermicompost @ 2t/ha + PSB (Soil) @ 1.5 kg/ha + Seed treatment with *Azotobactor* @ 10 g/kg seed + $ZnSO_4$ @ 20 kg/ha (soil application as basal) *fb* Foliar spray of $ZnSO_4$ (0.5%) at just before flowering).

Keywords*: Azotobactor, crude protein yield, dry matter yield, green fodder, oat and zinc sulphate*

Influence of Pinching and gibberellic acid on Growth, Flowering, Yield in *Gypsophila paniculata L.*

Payel Jana[1*] Sumita Pradhan[2]

[1]M. Sc., Department of Floricultural Medicinal and Aromatic Plants, Faculty of Horticulture, Uttar Banga Krishi Viswavidyalaya (UBKV), Pundibari, Cooch Behar, West Bengal, India.

[2]Department of Floricultural Medicinal and Aromatic Plants, Faculty of Horticulture, Uttar Banga Krishi Viswavidyalaya (UBKV), Pundibari, Cooch Behar, West Bengal, India.

Correspondence author's E-mail: janapayel12@gmail.com

Abstract

Gypsophila paniculata L. is a commercially important cut flower valued for its delicate appearance, long vase life and extensive use in bouquets and floral arrangements. Its significance is increasing rapidly with the expansion of the global cut flower industry, where it is used both as a filler and as a standalone ornamental flower. The present investigation was conducted at Instructional farm, during 2025-26 at the Department of Floriculture, Medicinal and Aromatic Plants, Uttar Banga Krishi Viswavidyalaya, West Bengal, to evaluate the effect of pinching and gibberellic acid (GA*f*) on the growth, flowering and yield of gypsophila. The experiment was laid out in a Factorial Randomized Block Design comprising of three pinching treatments (no pinching, pinching at 15 DAT and pinching at 30 DAT) and four levels of GA*f* (0, 150, 300 and 450 ppm), resulting in twelve treatment combinations. The observations revealed that both pinching and GA*f* application markedly influenced plant growth and flower production. Among the treatments, pinching at 15 DAT along with 450 ppm GA3 reported maximum plant spread (48.34 cm), leaf area (22.17 cm2) and highest fresh weight of aerial biomass while pinching at 15 DAT and 300 ppm GA3 reported highest number of primary branches per plant (21.4 branches/plant), and maximum number of marketable stems per plant.

The study indicates that timely pinching combined with optimum GA*f* application can substantially improve plant architecture, flowering potential and flower stalk yield in *Gypsophila paniculata*.

Keywords: *Gypsophila paniculata, Baby's Breath, GAf , pinching, growth, flowering.*

Enhancing Productivity, Profitability and Climate Resilience through Maize-Based Intercropping Systems in North Bengal

Prateek Madhab Bhattacharya[1], Biplab Mitra[1], Abhas Kumar Sinha[1], Kalyan Kanti Das[1], Arunava Ghosh[1], Moumita Roy[2*]

[1]Uttar Banga Krishi Viswavidyalaya, Pundibari, Coochbehar, 736165, West Bengal, India

[2]Visva-Bharati University, Sriniketan, Birbhum, 731236, West Bengal, India

Corresponding email id- roymoumita848@gmail.com

Abstract

Maize cultivation is rapidly expanding in North Bengal; however, sole maize production often exposes farmers to climatic uncertainties, market fluctuations, and nutritional limitations. The present study evaluated the potential of maize-based intercropping systems as a sustainable intensification strategy through socio-economic surveys, on-station experiments, and participatory field trials conducted in the districts of Cooch Behar and Malda. A multistage random sampling approach was used to survey 408 farmers, including 123 intercrop adopters and 285 non-adopters, to assess awareness, perceptions, and adoption potential of intercropping systems. Survey results revealed that while 86.5% of farmers were aware of intercropping, only 15.4% practiced it. Intercrop farmers perceived significant improvements in productivity, profitability, food diversity, livestock feed availability, soil health, and confidence in farming compared with non-intercrop farmers. Experimental evaluations demonstrated that widening maize row spacing (80:40 cm) enabled successful integration of vegetables, legumes, leafy greens, and cole crops without reducing maize yield. Among the tested intercrops, broccoli, cauliflower, cabbage, spinach, fenugreek, garden pea, and coriander showed substantial advantages in maize equivalent yield, net returns, and benefit-cost ratio. Broccoli-based intercropping recorded the highest maize equivalent yield (1330.0 kg per 600 m²), net income (¹ 14,404.66 per 600 m²), and B:C ratio (3.69). The findings indicate that maize intercropping can increase system productivity by 12–60%, improve economic returns by 10–40%, reduce climate-related risks through income diversification, enhance household nutrition, and provide additional livestock feed resources. The study highlights the considerable scope for scaling up maize-based intercropping in North Bengal, with broccoli, garden pea, beans, and leafy vegetables emerging as promising intercrops for sustainable agricultural development and climate-resilient farming systems.

Keywords: *Climate resilient agriculture, Income generation, Intercropping system, Profitability, Sustainability*

Statistical Modeling of Selected Fertilizer Prices using Time Series Approach

Prema Borkar
Assistant Professor
Gokhale Institute of Politics and Economics (Deemed University), Pune – 411004.
Maharashtra.India.
Email: prema.borkar@gipe.ac.in, premaborkar@gmail.com

Abstract

Fertilizers have been crucial to agricultural productivity because they give crops the nutrients they need and have seen rising demand throughout time. India is an agrarian nation with many small and marginal farmers and is frequently hampered by low production and bad quality. Over time, the majority of crops are rain-fed and grown on a single plot of land, which reduces soil fertility in many areas. This has led to an increase in the use of nitrogen fertilizers in the nation. In order to enhance production, the Indian government has implemented economic reforms and made sure that fertilizers are readily available at reasonable costs. The Indian fertilizer sector has been able to increase the nation's food security as a result of the fertilizers' eligibility for subsidies when they are notified. Despite the fact that the usage of fertilizers in agriculture is crucial, practically all of the demand for chemical fertilizers has been satisfied

by the government. The present study aims to study the monthly fertilizer prices of DAP, Potassium Chloride, Rock Phosphate, Triple Superphosphate, and Urea from India. The data were gathered from different fertilizer-related websites between July 2017 and April 2026. The ARIMA model was used to fit the data and forecast future fertilizer prices. For forecasting, the Box-Jenkins (1970) ARIMA methodology has been applied. The data was examined using autocorrelation and partial autocorrelation functions. The R programming software was used to estimate model parameters. The performance of the fitted model was examined by computing various measures of goodness of fit viz., AIC, BIC, and MAPE. Based on the chosen model, projections for the period from May 2026 to December 2026 are computed. The results of the monthly fertilizer prices are shown numerically and graphically. Forecasting is a critical phase in the process of advising policymakers. When developing, planning, and executing marketing strategies, strategists consider the most accurate forecasting models. These projections are particularly helpful for modifying their marketing and policy initiatives in order to account for changes in the future.

Keywords: *ACF - Autocorrelation Function, AIC – Akaike Information Criterion, ARIMA – Autoregressive Integrated Moving Average, Fertilizer prices, MAPE - Mean Absolute Percent Error, PACF - Partial Autocorrelation Function, Residual Analysis.*

Green synthesis mediated by *Mucuna pruriens* seed extract to investigate antioxidant activity and cytotoxic effects.

Rajani Shirsat[1], Kartik Aptekar[2], Ajit Kengar[1]*

[1] KET's V.G. Vaze College of Arts, Science & Commerce (Autonomous), Mumbai, India

[2]Amity Institute of Biotechnology, Mumbai

Corresponding Author-ajitkengar@vazecollege.net

Abstract

Green synthesis has emerged as an eco-friendly and sustainable approach for producing nanoparticles in recent years. It utilises biological materials like plant extracts, bacteria, fungi, algae, and biomolecules to synthesise nanoparticles from metal ions. *Mucuna pruriens* (L.) DC, commonly known as velvet beans, is an important medicinal plant in the Fabaceae family. Its main bioactive component, L-DOPA, is a precursor to dopamine, a neurotransmitter involved in controlling movement, emotions, and various brain functions. A decrease in dopamine levels is a primary cause of Parkinson's disease, leading to symptoms such as tremors, stiffness, and impaired motor control. Due to its potential as a herbal treatment, natural L-DOPA from *Mucuna pruriens* has garnered considerable research interest. Studies indicate that this plant has neuroprotective properties that may help reduce oxidative damage linked to neurodegenerative diseases. Recent research confirmed the green synthesis of nanoparticles through NTA analysis and demonstrated effective antioxidant activity via DPPH assays, with maximum inhibition at 75 µL and 100 µl concentrations. Cytotoxicity tests using Dapnia spp. cultures showed increased toxicity with higher concentrations. Overall, *Mucuna pruriens* appears to be a promising source of L-DOPA, potentially advancing nanotechnology-based drug therapies targeting blood-brain barrier cells.

Keywords: *Nanoparticle, Green Synthesis, Mucuna pruriens, L-DOPA, Antioxidant, Cytotoxicity*

Exploration of antifungal activity of *Beauveria bassiana* isolates against the Chickpea Stem rot pathogen *Sclerotinia sclerotiorum*

Roshini Cheruku* and Tusar Kanti Bag
Division of Plant Pathology, ICAR-Indian Agricultural Research Institute, Pusa, New Delhi 110012
Presenter, email id: roshini.c1999@gmail.com

Abstract

Stem rot of chickpea caused by *Sclerotinia sclerotiorum* is a major constraint to chickpea production owing to its wide host range, prolonged survival through sclerotia, and limited efficacy of conventional control measures. The present investigation was undertaken to evaluate the antagonistic potential of *Beauveria bassiana* isolates against *S. sclerotiorum* and to explore the role of fungal metabolites in pathogen suppression. Twenty isolates of *B. bassiana* were screened under in vitro conditions using a dual-culture assay. Considerable variation was observed among the isolates with respect to inhibition of pathogen growth. One isolate exhibited superior antagonistic activity, reducing mycelial growth of *S. sclerotiorum* by nearly 50% compared with the untreated control. Further studies indicated that the antagonistic effect was associated with extracellular bioactive metabolites produced by the fungus. Preliminary chromatographic and spectroscopic analyses of the active fraction revealed the presence of a putative antifungal compound. The results demonstrate the potential of selected *B. bassiana* isolates as effective biological agents against *S. sclerotiorum* and provide a basis for further investigations on metabolite-mediated disease suppression in chickpea. These findings emphasize the expanding role of entomopathogenic fungi in integrated disease management strategies.

Keywords*: Beauveria, Sclerotinia, Metabolites, Chickpea,*

Climate Change Adaptation, Ecosystem Resilience and Sustainable Agricultural Transformation: Evidence from NICRA-TDC Demonstrations in West Bengal and Odisha

Ria Bhattacharya, S K Mondal*, K S Das, S K Roy, A Haldar and P Dey
ICAR-Agricultural Technology Application Research Institute Kolkata, Salt Lake, Kolkata, West Bengal
****Corresponding Email ID: sk_mondal@yahoo.com***

Abstract

Climate change threatens environmental ecology and agricultural sustainability in eastern India. To address recurring floods, droughts, cyclones, salinity intrusion, and heat waves in West Bengal and Odisha, NICRA-TDC implemented location-specific adaptation and mitigation strategies to enhance ecosystem and farming system resilience.The study synthesized five-year outcomes of NICRA climate-resilient technologies across 16 vulnerable districts of West Bengal and Odisha, covering natural resource management, crop production, livestock, fisheries, and institutional innovations.The demonstrated interventions substantially enhanced ecological resilience, agricultural sustainability, and livelihood security. Rainwater harvesting structures increased irrigation availability, water storage, and cropping intensity, while land shaping, mulching, and conservation agriculture improved soil moisture retention, reduced salinity and nutrient losses, and enhanced soil health. Land-use efficiency improved through the conversion of barren lands into productive rice–vegetable systems. Climate-resilient crop varieties

increased yields by 22–38% under drought, flood, and saline conditions, while zero tillage reduced fuel use, labour requirements, and carbon emissions. Adoption of stress-tolerant varieties increased farm income by about 30% and improved food security. Livestock interventions, including improved goat shelters, reduced disease incidence and mortality by up to 35% and enhanced environmental hygiene in flood-prone areas. Community-based institutions such as seed banks, fodder banks, custom hiring centres, village weather stations, and VCRMCs strengthened resource management, technology dissemination, and farmers' access to farm machinery, which increased by nearly 75%. Overall, cropping intensity increased up to 260%, farm income rose by 20–27%, and rural migration declined due to improved livelihood opportunities.The findings demonstrate that integrated climate-resilient technologies under NICRA-TDC effectively mitigate the adverse impacts of climate change on environmental ecology while improving agricultural productivity, natural resource conservation, and livelihood security. The project provides a scalable model for promoting climate-smart agriculture and ecosystem-based adaptation strategies in vulnerable agro-ecological regions of India.

Keywords: *Climate change, adaptation, mitigation, climate-resilient agriculture, NICRA-TDC, natural resource management, climate-smart technologies*

Liposomal Nanoformulations for Antidiabetic Drug Delivery: Recent Advances, Therapeutic Potential, and Translational Challenges

Sajjad Husain Ansari*, Sunita Sumit Deore
Department of Quality Assurance, School of Pharmaceutical Sciences, Sandip University, Nashik, Maharashtra, India.
***Corresponding Author:** Ansari Sajjad Husain Mumtaz Ahmad
Department: School of Pharmaceutical Sciences, Sandip University, Nashik, Maharashtra, India.
Email: ansarisajjad.dhl@gmail.com
Co Author: Sunita S. Deore, Department: School of Pharmaceutical Sciences, Sandip University, Nashik, Maharashtra, India.

Abstract

Diabetes mellitus is a chronic metabolic disorder requiring long-term pharmacotherapy, often limited by poor drug solubility, low oral bioavailability, frequent dosing, and inadequate patient compliance. Liposomal nanoformulations have emerged as promising drug delivery systems capable of enhancing the therapeutic performance of antidiabetic agents through improved drug encapsulation, targeted delivery, controlled release, and prolonged systemic circulation. This review discusses the structural characteristics and functional advantages of liposomes as nanocarriers for antidiabetic therapeutics, including oral hypoglycemic agents and insulin-based therapies. Recent advances in liposomal technology, such as surface modification, ligand-mediated targeting, PEGylation, and stimuli-responsive systems, are highlighted for their potential to improve therapeutic outcomes. The review further examines challenges associated with formulation stability, large-scale manufacturing, regulatory approval, and clinical translation. Emerging trends involving artificial intelligence-assisted formulation design, nanotechnology-driven optimization, and hybrid lipid-based delivery systems are also explored. Collectively, the available evidence suggests that liposomal drug delivery systems represent a promising strategy for improving the efficacy, safety, and patient acceptability of antidiabetic therapy while facilitating the development of next-generation nanomedicines for diabetes

management.

Keywords: *Liposomes; Nanoformulations; Antidiabetic Drug Delivery; Diabetes Mellitus; Targeted Drug Delivery; Controlled Release; Oral Bioavailability; Nanomedicine; Insulin Delivery; Pharmacokinetics; Lipid-Based Nanocarriers; Drug Targeting.*

Comparative Evaluation of Natural Farming and Conventional Farming Systems through diversified crop cultivation in Cooch Behar District

[1]Sandip Hembram, [1]Samima Sultana*, [1]Sankar Saha, [1]Suraj Sarkar, [1]Rahul Deb Mukherjee, [2]Prabhat Kumar Pal and [3] Avijit Haldar

[1]Cooch Behar Krishi Vigyan Kendra, Uttar Banga Krishi Viswavidyalaya, Cooch Behar
[2]Uttar Banga Krishi Viswavidyalaya, Cooch Behar
[3]ICAR - ATARI, Kolkata
Corresponding author: samima.ubkv@gmail.com

Abstract

This study presents a comprehensive comparative analysis of Natural Farming (NF) and Conventional Farming (CF) systems, assessing crop yield, cost of cultivation, gross and net returns, benefit-to-cost (B:C) ratios, and soil health dynamics across three cropping seasons in three different villages of Cooch Behar District during the year of 2024-2025 and 2025-26. Economic analysis revealed that natural farming reduced the cost of cultivation while maintaining comparable yields with conventional farming. Under natural farming, higher benefit-cost (B:C) ratios were recorded in several crops, including pre-kharif tomato (2.54), maize (2.45), leafy vegetables (2.17), and rice (1.79). Net returns were also substantially higher in crops such as tomato, brinjal, okra, and broccoli due to lower external input costs and improved market value of produce. In comparison, conventional farming recorded relatively lower B:C ratios in cabbage (1.39), cauliflower (1.34), and rice (1.73). Under the Natural Farming system, pre-Kharif crops such as maize (B:C 2.45), tomato (B:C 2.54), and okra (B:C 1.99) emerged as highly profitable. Soil health monitoring across five farmer fields revealed overall improvement in pH, available nitrogen, phosphorus, and potassium following the cropping cycle, affirming the soil-restorative potential of Natural Farming practices. The research findings advocate for the inclusion of Natural Farming principles in smallholder crop management strategies as a means of enhancing profitability while promoting soil ecological integrity.

Keywords: *Natural farming, conventional farming, B:C ratio, net return, soil health, Rabi, Kharif, vegetable crops, rice, maize, organic carbon*

Geospatial Analysis of Soil Attributes and Management Zone Delineation in the Tea-Growing Areas of Terai, West Bengal

Sayantan Mandal[1*], Avinaba Maji[2], Sushanta Saha[2]

[1]Department of Soil Science, IARI-KOLKATA, CRIJAF, Barrackpore, Kolkata, 700120)
[2]Department of Agril. Chem. and Soil Science, Faculty of Agriculture, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal-741 252, India
Author for correspondence: E-mail: sayantanmandal456@gmail.com

Abstract

Sustainable soil management requires a comprehensive understanding of the spatial variability of soil properties to optimize crop productivity while mitigating land degradation. In India, the world's second-largest tea-producing nation, prolonged monoculture cultivation has contributed to the deterioration of soil fertility in major tea-growing regions, including the Terai and Dooars. This study was undertaken to characterize the spatial variability of key soil properties and delineate soil management zones (MZs) for site-specific nutrient management in tea plantations of Jalpaiguri district, West Bengal.

A total of 78 geo-referenced surface soil samples (0–0.20 m depth) were collected from tea estates located in the Mal, Matiali, and Nagrakata blocks. The samples were analyzed for soil pH, organic carbon (OC), available nitrogen (N), phosphorus (P), potassium (K), sulphur (S), boron (B), and DTPA-extractable zinc (Zn), copper (Cu), iron (Fe), and manganese (Mn). Descriptive statistical analysis revealed substantial variability among the measured soil properties, with coefficients of variation ranging from 11.2% to 43.9%, indicating low to moderate heterogeneity. Geostatistical analyses using semivariogram modelling and ordinary kriging demonstrated moderate to strong spatial dependence for most soil attributes.

Principal component analysis (PCA) extracted five principal components with eigenvalues greater than one, collectively explaining 65.6% of the total variance. These components were subsequently employed in fuzzy c-means clustering to delineate management zones. Based on the fuzzy performance index (FPI) and normalized classification entropy (NCE), five distinct MZs were identified. Significant differences in soil fertility parameters among the delineated zones highlighted the inherent spatial heterogeneity of the tea-growing landscape.

The integration of multivariate statistical techniques and geostatistical tools proved effective in delineating site-specific management zones for tea plantations. The identified MZs provide a scientific basis for precision nutrient management, enabling improved nutrient-use efficiency, sustained productivity, and enhanced soil health. Furthermore, the proposed approach has broad applicability for precision soil management in other cropping systems and agroecological regions.

Keywords: *Geostatistical analysis; management zones; principal component analysis; semivariogram; spatial variability, tea plantation*

Effect of Growth Regulators on Seed Germination Behaviour of *Arctium lappa* L. Under Different Temperature

Smriti Bhattarai[1]*, R.S. Chauhan[2] and Dipak kumar Murmu[3]

[1]Department of Plantation Crops and Processing, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar–736165, West Bengal, India.

[2]Assistant Professor, Department of PSMAP, CoH, Veer Chandra Singh Garhwali Uttarakhand University of Horticulture and Forestry, Bharsar.

[3]Assistant Professor in Vegetables and Spice Crops, RRS (OAZ), UBKV, Majhian, Blaurghat, Dakshin Dinajpur.

Corresponding author e-mail: smritibhattarai1599@gmail.com

Abstract

The present investigation was carried out on Arctium lappa at MAP Laboratory and poly-house, CoH, V.C.S.G. UUHF, Bharsar, Pauri Garhwal during the year 2024. The study comprises of Ten (10) treatments, including different plant growth regulators. GA_3, Thiourea and KNO_3 (50, 100, 150 ppm) with control under two temperature 20! and 25!. In order to get desired results, seeds were soaked for 24 hours in different treatments of desired concentrations. Then seeds were removed from the solution and thoroughly washed. After treatments, seeds were placed on moist filter paper in petri plates (20 seeds/petri plate with triplicate) and kept in incubator set at a temperature of 20 ± 2! and 25 ± 2!. The study evaluated the effect of different seed treatments and temperatures (20°C and 25°C) on germination and vegetative growth of *Arctium lappa* L. Results showed that GA*f* @ 150 ppm (T_4) significantly improved germination parameters, recording the earliest radicle emergence, highest germination percentage, germination energy, germination speed, and survival. GA*f* @ 100 ppm (T_3) produced the longest root length at both temperatures. (KNO_3 @ 150 ppm) T_{10} was superior for vegetative growth, resulting in maximum leaf length, number of leaves, shoot and root biomass, seedling biomass, Seedling Vigour Indices I and II, and survival at 25°C. Overall, T_4 (GA*f* @ 150 ppm) was the best treatment for seed germination, T_3 (GA*f* @ 100 ppm) for root development, and T_{10} (KNO_3 @ 150 ppm) for vegetative growth and seedling vigour of *Arctium lappa* L.

Keywords: *Seed germination, Seedlimg vigour,Temperature, GA_3, Thiourea, KNO_3.*

Screening of Advanced Mungbean Genotypes for Resistance to Mungbean Yellow Mosaic Virus (MYMV) under Terai region of West Bengal

Sourav Kar, Avralima Sarkar, Arup Sarkar

Department of Genetics and Plant Breeding, Uttar Banga Krishi Viswavidyalaya

****Corresponding author e-mail: karsourav2605@gmail.com***

Abstract

Mungbean (*Vigna radiata* L. Wilczek) is an important pulse crop grown extensively for its high nutritional value and contribution to sustainable agriculture. However, its productivity is often threatened by Mungbean Yellow Mosaic Virus (MYMV), a whitefly-transmitted disease that can cause severe yield losses under favorable conditions. The present study was conducted to evaluate forty-three advanced mungbean genotypes for their reaction to MYMV under natural field conditions and to identify promising sources of resistance for use in breeding programmes. Disease incidence and disease severity were recorded using a standard 0–9 disease rating scale. Considerable variability was observed among the genotypes for both disease incidence and disease severity. The disease incidence ranged from 1.29% to 45.46%**,** while the mean disease score varied from 0.6 to 6.8**.** Based on disease scores, seven genotypes were classified as resistant, twenty-six as moderately resistant, five as moderately susceptible, and three as susceptible, whereas no genotype was found to be highly susceptible. Genotypes IPM-21-22-11 and IPM-21-23-13 recorded the lowest disease scores (0.6 and 0.8, respectively) along with very low disease incidence, indicating a high level of resistance to MYMV. In contrast, genotypes IPM-1718-2**,** IPM-1620-6**,** and IPM-1703-2 exhibited higher disease scores and incidence levels, reflecting their susceptibility to the disease. The results demonstrate the presence of substantial genetic variability for MYMV resistance among the evaluated mungbean genotypes. The resistant and moderately resistant genotypes identified in this study can serve as valuable donor parents for developing MYMV-resistant

cultivars and may contribute to enhancing yield stability and disease resilience in mungbean-growing regions.

Keywords: *Vigna radiata, MYMV, disease incidence, disease severity, resistance screening, mungbean breeding.*

Theme: Recent Advances in Biological & Applied Sciences
Subtheme: Application of intellectual property rights (IPR) in science and technology
Title: Rethinking Intellectual Property Rights in the Age of Artificial Intelligence

[1]Suchandrika Hazra*, [2]Prabhat Kumar Pal and [3]Rahul Deb Mukherjee
[1]Post Doctoral Fellow, Department of Agricultural Extension, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar – 736165
[2]Professor & Head, Department of Agricultural Extension, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar – 736165
[2]Subject Matter Specialist (Animal Science), Cooch Behar KVK, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar – 736165
Corresponding author: suchandrika15@gmail.com

Abstract

Artificial Intelligence (AI) is reshaping how science and technology produce knowledge, yet the legal frameworks governing intellectual property rights (IPR) have not kept pace with this shift. IPR systems built around the Berne Convention (1886) and the TRIPS Agreement (1994) rest on the assumption that inventions and creative works originate from human minds an assumption that AI increasingly challenges. This study investigates five real world cases where this mismatch between technological reality and legal expectation has produced serious ethical problems. The first is the DABUS dispute, in which patent offices in the United States (Thaler v. Vidal, 2022) and Europe refused to grant patents for AI generated inventions because no human inventor could be named. The second concerns the AI produced painting "Théâtre D'Opéra Spatial," which won a fine arts competition in Colorado (2022) and sparked public debate about whether machine-created works deserve copyright protection. The third involves legal action brought against OpenAI and Stability AI (Andersen et al. v. Stability AI, 2023; The New York Times v. OpenAI, 2023) for training generative AI models on copyrighted content without permission or compensation. The fourth is the landmark Indian case ANI Media Pvt. Ltd. v. OpenAI Inc. [CS(COMM) 1028/2024], filed before the Delhi High Court in November 2024, in which the Asian News International news agency alleged that OpenAI scraped its copyrighted articles, including paywalled content, to train ChatGPT without authorisation or licensing. The case raises questions about the scope of fair dealing under Section 52 of the Copyright Act, 1957 and with judgment now reserved after 32 hearings, it is set to become India's defining legal precedent on AI and copyright. The fifth is the growing problem of AI assisted plagiarism in academic publishing, flagged by COPE (2023) and Springer Nature (2023) as a threat to research integrity. Using cross case thematic analysis grounded in WIPO's AI and IP policy framework (2022) and the OECD Principles on Responsible AI (2019), the study identifies five recurring problems: unclear ownership, disputed attribution, absence of informed consent, lack of transparency and fragmented regulation across jurisdictions. The cases collectively show that current IPR law is poorly equipped to handle AI driven innovation and practical reforms are needed, including dedicated IP categories for AI outputs, mandatory disclosure of AI involvement and

coordinated international standards. The inclusion of an Indian case reflects the genuinely global reach of these challenges and speaks to the urgent need for reform within national legal systems as much as at the international level.

Keywords: *Intellectual Property Rights; Artificial Intelligence; Research Ethics; Copyright; Patent Law; Innovation Governance*

From Food Security to Nutritional Security: Development and Application of the Nutri-PDS Effectiveness Index

Surjya Kanta Roy[1*], Satyapriya[2], Sujay B. K[3] and Pradip Dey[1]
[1]ICAR-Agricultural Technology Application Research Institute, Kolkata, W.B. - 700097
[2]ICAR-Indian Agricultural Research Institute, Pusa Campus, New Delhi - 110012
[3]ICAR-Indian Institute of Agricultural Biotechnology, Ranchi, Jharkhand 834003
Corresponding author e-mail: surjyakantaroy1995@gmail.com

Abstract

The Public Distribution System (PDS) has been a cornerstone of India's food security framework, ensuring access to subsidized food grains for vulnerable populations. While the system has substantially contributed to reducing hunger and improving food access, its focus remains largely confined to the provision of staple cereals, with limited attention to nutritional adequacy. As a result, deficiencies in the consumption of protein-rich and micronutrient-dense foods continue to persist among beneficiary households, necessitating a paradigm shift from food security to nutritional security. In this context, assessing the effectiveness of the PDS through a nutrition-sensitive lens becomes imperative. The present study aimed to develop and apply a Nutri-PDS Effectiveness Index (NPEI) for evaluating the contribution of the PDS towards nutritional security. The study was conducted in the Bundelkhand region, a nutritionally vulnerable area spanning parts of Uttar Pradesh and Madhya Pradesh. Four districts- Jhansi, Chitrakoot, Tikamgarh, and Chhatarpur- were selected based on their Multidimensional Poverty Index (MPI) status and inclusion among aspirational districts. A sample of 320 PDS beneficiary households was surveyed using a structured interview schedule. The Nutri-PDS Effectiveness Index was developed using a multidimensional framework comprising six dimensions: accessibility, supply management mechanism, beneficiary satisfaction, cost savings, viability, and nutritional contribution. These dimensions were operationalized through twelve attributes and forty-seven indicators. An Integrated Weightage Method (IWM) was employed to assign weights and compute composite scores for each dimension and district. The findings revealed that Tikamgarh achieved the highest Nutri-PDS Effectiveness Index score, followed by Chitrakoot, Chhatarpur, and Jhansi, indicating significant inter-district variations in the effectiveness of PDS implementation. Accessibility, beneficiary satisfaction, and cost savings emerged as the most influential dimensions affecting overall effectiveness. Operational cost efficiency and exclusive allocation of food grains were the highest-performing attributes, reflecting the system's ability to ensure affordability and access among vulnerable households. However, lower scores related to nutritional contribution and beneficiary satisfaction underscored the need for improving the quality, diversity, and nutritional value of commodities distributed through the PDS. The study demonstrates that the Nutri-PDS Effectiveness Index provides a robust and comprehensive framework for assessing PDS performance beyond conventional food security outcomes. The findings advocate for the integration of nutrition-sensitive interventions within the PDS, including diversification of food

baskets, nutrition awareness initiatives, and strengthened service delivery mechanisms. The proposed index can serve as a valuable policy tool for monitoring, benchmarking, and guiding reforms aimed at transforming India's PDS from a food security programme into an effective instrument for achieving nutritional security.

Keywords: *Nutritional Security, Public Distribution System, Nutri-PDS Effectiveness Index, Composite Index, Integrated Weightage Method, Food System Transformation.*

Evaluation of qualitative trait- based variability among gladiolus genotypes

Susmita Thapa[1*] Arpita Mandal Khan[2]

[1] M. Sc., Department of Floricultural Medicinal and Aromatic Plants, Faculty of Horticulture, Uttar Banga Krishi Viswavidyalaya(UBKV), Pundibari, Cooch Behar, West Bengal, India.

[2.] Department of Floricultural Medicinal and Aromatic Plants, Faculty of Horticulture, Uttar Banga Krishi Viswavidyalaya(UBKV), Pundibari, Cooch Behar, West Bengal, India.

****Correspondence author's E-mail: susmitathapa0909@gmail.com***

Abstract

Gladiolus (*Gladiolus grandiflorus* L.) is one of the most important ornamental cut flowers, valued for its attractive spikes, diverse flower colours, and excellent vase life. Understanding the extent of genetic diversity among available genotypes is essential for effective breeding and cultivar improvement. The present study was conducted during 2024-2025 at the Instructional Farm of the Department of Floriculture, Medicinal and Aromatic Plants, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal, India to assess the genetic diversity among 31 gladiolus genotypes based on 17 qualitative traits. Qualitative traits were recorded according to the DUS guidelines of PPV&FR and analysed using Shannon's Diversity Index (H), Simpson's Diversity Index (D), and UPGMA cluster analysis. A wide range of variation was observed among the genotypes, indicating substantial diversity. Flower main colour exhibited the highest diversity (H=1.82; D = 5.43), followed by flower secondary colour (H = 1.75; D = 4.78) and perianth tube colour (H = 1.67; D = 4.16), highlighting their importance in distinguishing genotypes. In contrast, spike arrangement of flowers showed the lowest diversity (H = 0.38; D = 1.29). UPGMA clustering further revealed distinct relationships among the genotypes, with both closely related and highly divergent groups. The study revealed the effectiveness of qualitative traits in assessing genetic diversity and differentiating gladiolus genotypes. The diverse germplasm identified in this study can serve as a valuable resource for selection of parents and development of improved gladiolus cultivars with enhanced ornamental value and market appeal.

Keywords: *Gladiolus, genetic diversity, qualitative traits, DUS characterization, UPGMA clustering, ornamental breeding*

Machine Learning based Prediction of Copy Number variations in Plant Genome

Parinita Das[1, 2]

[1]Department of Agricultural Biotechnology & Molecular Biology, College of Basic Sciences and Humanities, Dr Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar, India

[2]Division of Agricultural Bioinformatics, ICAR-Indian Agricultural Statistics Research Institute, New Delhi, India

Email: parinitadas@rpcau.ac.in

Structural variations (CNVs), including deletions and duplications, represent a major source of large-scale variation in plant genomes (>1000bp) and are known to influence agronomically important traits. Accurate classification of CNV types remains challenging due to genome size, high repeat content, and heterogeneous sequencing coverage commonly observed in plant genomes. In this study, we present a Gradient Boosting-based machine learning framework for the prediction and classification of CNV types- deletions, duplications, and non-CNV regions in plant genomes. The proposed approach utilizes features derived from sequencing depth profiles, nucleotide composition, and coverage-related statistics that capture key characteristics of CNV regions. The model was trained using a high-confidence dataset comprising both experimentally validated and computationally curated CNVs, ensuring robustness across diverse genomic contexts. Performance evaluation was conducted across multiple CNV size ranges and varying training set sizes to assess model stability and generalization capability. The Gradient Boosting model demonstrated strong and consistent performance, achieving an overall classification accuracy of 89.27%, with precision, recall, and F1-score values of 89.3%, and a receiver operating characteristic area under the curve (AUC) of 0.9783. These results highlight the reliability of the proposed framework in distinguishing CNV types in complex plant genomes. This method focuses on accurately classifying CNV types from pre-identified genomic regions, thereby complementing existing CNV detection pipelines. The approach offers a scalable and efficient solution for CNV classification, with potential applications in plant genomics, breeding, and evolutionary studies.

Keywords: *Machine Learning, Plant Genomics, Structural Variation, Deletion, Duplication*

Nutrient-enriched wheat for sustainable food, nutrition and health security

***Vikas Gupta**
ICAR- Indian Institute of Wheat and Barley Research, Karnal-132001, Haryana
Corresponding author email id: vikasdwr@gmail.com

Abstract

Hidden hunger, caused by deficiencies of essential micronutrients such as iron (Fe), zinc (Zn), vitamins, and proteins, remains a major global public health challenge. More than two billion people worldwide suffer from malnutrition, with children and women being the most vulnerable groups. In India, high levels of stunting, underweight children, and anaemia continue to threaten human health, productivity, and socio-economic development. Conventional interventions such as dietary diversification, food fortification, and medical supplementation have contributed to alleviating micronutrient deficiencies; however, their effectiveness is often limited by economic, infrastructural, and accessibility constraints. Biofortification has emerged as a sustainable, cost-effective, and farmer-friendly strategy to address hidden hunger by enhancing the nutritional quality of staple food crops through plant breeding and biotechnology. Wheat, a primary staple food for a large proportion of the global population, offers immense potential for delivering essential micronutrients through biofortification. The major focus of wheat biofortification programs has been the enhancement of grain iron and zinc concentrations while maintaining high yield potential, adaptability, and consumer acceptability. Significant progress has been achieved through the utilization of diverse genetic resources, including synthetic hexaploid wheats and related *Triticum* species. In India, several biofortified wheat varieties such as WB 02, DBW 187, DBW 327, DBW 371, DBW 372, and DBW 443 have been developed and released, possessing elevated

levels of iron, zinc, and protein along with superior agronomic performance. Notably, DBW 443 represents a triple biofortified wheat variety enriched with protein, iron, and zinc. Biofortified wheat offers several advantages, including wide reach among low-income populations, minimal recurring costs, sustainability, and integration into existing farming systems. By providing nutrient-dense grain through a commonly consumed staple, biofortification contributes significantly to improving nutritional security, reducing micronutrient deficiencies, and supporting national and global efforts toward achieving better health and food security.

Keywords: *Hidden hunger, biofortification, iron, zinc, protein, nutritional security, micronutrient malnutrition*

Emerging Issues in Environmental Management: Role of Red Mud in Sustainable Wastewater Treatment

Maruwada Srinivasan[1], Ramprasad Naik Desavathu[2], Rakesh Roshan Dash[3]

[1]Research Scholar, Dept. of Civil Engineering, Gandhi Institute of Engineering and Technology University,Gunupur, Odisha, India. Email: srinivasan.maruwada@giet.edu

[2]Professor, Dept. of Civil Engineering, Gandhi Institute of Engineering and Technology University, Gunupur, Odisha, India. Email: dnaik@giet.edu.

[3]Associate Professor, Dept. of Civil Engineering, VSSUT Burla, Sambalpur, Odisha, India,

Email: rrdash@gmail.com

Abstract

The increasing discharge of industrial wastewater containing heavy metals, dyes, and other toxic pollutants has created a significant environmental challenge worldwide. Simultaneously, large quantities of industrial by-products such as red mud and fly ash are generated from alumina refineries and thermal power plants, respectively. The disposal of these wastes poses serious environmental concerns, including land degradation, groundwater contamination, and air pollution. The utilization of red mud and fly ash as low-cost adsorbents offers a sustainable solution to both waste management and wastewater treatment problems. Red mud is rich in iron oxide, aluminum oxide, titanium oxide, and silica, while fly ash contains silica, alumina, calcium oxide, and unburnt carbon, making both materials suitable for adsorption applications. Numerous studies have demonstrated their effectiveness in removing heavy metals such as lead, cadmium, chromium, copper, and zinc, as well as dyes and other contaminants from industrial effluents. Surface modification and activation techniques further enhance their adsorption capacities and treatment efficiencies. The use of red mud and fly ash as adsorbents supports waste valorization, resource recovery, and circular economy principles by converting industrial wastes into valuable environmental remediation materials. Their low cost, wide availability, and significant pollutant removal potential make them attractive alternatives to conventional adsorbents such as activated carbon. This study highlights the characteristics, adsorption mechanisms, environmental benefits, and future prospects of red mud and fly ash in sustainable industrial wastewater treatment, emphasizing their role in promoting environmentally responsible waste utilization and pollution control.

Key words: *Red Mud, Industrial Effluent Treatment, Adsorption, Waste Valorization, Circular Economy, Heavy Metal Removal, Sustainable Wastewater Treatment.*

Green synthesis mediated by *Mucuna pruriens* seed extract to investigate antioxidant activity and cytotoxic effects

Rajani Shirsat[1], Kartik Aptekar[2], Ajit Kengar[1]*

[1]KET's V.G.Vaze College of Arts, Science & Commerce (Autonomous), Mumbai, India
[2] Amity Institute of Biotechnology, Mumbai
***Corresponding Author-ajitkengar@vazecollege.net**

Abstract

Green synthesis has emerged as an eco-friendly and sustainable approach for producing nanoparticles in recent years. It utilises biological materials like plant extracts, bacteria, fungi, algae, and biomolecules to synthesise nanoparticles from metal ions. *Mucuna pruriens* (L.) DC, commonly known as velvet beans, is an important medicinal plant in the Fabaceae family. Its main bioactive component, L-DOPA, is a precursor to dopamine, a neurotransmitter involved in controlling movement, emotions, and various brain functions. A decrease in dopamine levels is a primary cause of Parkinson's disease, leading to symptoms such as tremors, stiffness, and impaired motor control. Due to its potential as a herbal treatment, natural L-DOPA from *Mucuna pruriens* has garnered considerable research interest. Studies indicate that this plant has neuroprotective properties that may help reduce oxidative damage linked to neurodegenerative diseases. Recent research confirmed the green synthesis of nanoparticles through NTA analysis and demonstrated effective antioxidant activity via DPPH assays, with maximum inhibition at 75 µL and 100 µl concentrations. Cytotoxicity tests using Dapnia spp. cultures showed increased toxicity with higher concentrations. Overall, *Mucuna pruriens* appears to be a promising source of L-DOPA, potentially advancing nanotechnology-based drug therapies targeting blood-brain barrier cells.

Keywords: *Nanoparticle, Green Synthesis, Mucuna pruriens, L-DOPA, Antioxidant, Cytotoxicity*

Recent Advances in Molecular Breeding and Genomics for Yield and Quality Improvement in Chilli (*Capsicum annuum* L.)

[1]Augusty Libang and [2]Ajaz Ahmed Malik

Ph.D. Scholar, Division of Vegetable Science, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Srinagar, J&K, India.
Associate Professor, Head KVK, Ganderbal, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Srinagar, J&K, India.

Abstract

Chilli (*Capsicum annuum* L.) ranks among the most economically and nutritionally significant vegetable crops worldwide, prized for its diverse pungency profiles, high antioxidant capacity, and broad culinary utility. However, the quantitative inheritance of yield-determining traits, the biochemical complexity of quality attributes including capsaicinoids and carotenoids, and the narrow genetic base of elite germplasm have collectively constrained the pace of conventional breeding. Recent advances in molecular breeding and genomics are substantially accelerating genetic improvement in this species. High-density SNP genotyping, chromosome-scale genome assemblies, and pan-genome construction across wild and cultivated *Capsicum* accessions have provided an unprecedented resolution of genomic architecture,

enabling fine mapping and functional characterization of loci governing fruit pungency (*Pun1*, *CS* cluster), pigmentation (*Psy*, *Lcyb*, *CCS*), and key agronomic traits. Marker-assisted selection and backcross introgression have facilitated the targeted transfer of favorable alleles from wild relatives into elite backgrounds with high precision. Genome-wide association studies conducted across multi-environment trials have revealed novel QTLs for capsaicinoid biosynthesis, ascorbic acid accumulation, disease resistance, and fruit morphology. Genomic selection models trained on dense marker profiles are demonstrating promising prediction accuracies for complex yield traits, offering the potential to compress breeding cycles by 30–50%. Concurrently, CRISPR/Cas9 editing has enabled precise functional dissection of biosynthetic genes and targeted modification of pungency and ripening pathways without linkage drag. Integration of transcriptomic, metabolomic, and phenomic datasets with machine learning platforms is further refining genotype-to-phenotype predictions. Despite these advances, challenges remain in translating genomic discoveries into field-level cultivar releases, particularly for smallholder farming systems. Bridging this gap through cost-effective genotyping pipelines and participatory breeding frameworks will be critical for deploying genomics-driven chilli improvement at scale.

Keywords: *Capsicum annuum, marker-assisted selection, genome-wide association study, genomic selection, CRISPR/Cas9, capsaicinoid biosynthesis*

A Study On Media Preferences Of Tribal Farmers In Hilly District Reasi Of Jammu &kashmir, India-research Article

Banarsi Lal*, Vikas Tandon, Amit Singh Charak***,Jasbir Singh Manhas**** , Suja Nabi Qureshi***** & Lobzang Stanzen********

*Chief Scientist & Head, KVK Reasi (SKUAST-J)-182301, **Dean, Faculty of Horticulture and Forestry, SKUAST-J,***Chief Scientist & Head, KVK Doda, SKUAST-J ,**** Professor,Division of Agricultural Extension Education, *****Suja Nabi Qureshi, Scientist, KVK Ganderbal, SKUAST-K & ****** Lobzang Stanzen,Asstt.Prof.,University of Ladakh

Corresponding author email address:dr.banarsi2000@gmail.com

Abstract

Timely information has great significance in the agricultural development. Information dissemination through highly preferred communication media constitutes one of the most striking developments of present era. It is fact that the Indian extension system is under lot of pressures where the extension workers have to cater the cervices of not only vast population but also to perform administrative, elections, input supply and numerous other assignments. Practically, it is not feasible to serve all the farmers, all the time for all the problems when ratio of extension worker and farmer is more than 1:1000.Thus, the potential of mass media can be exploited to serve the rural population of tribal farmers in the different areas. In order to increase the crop production in the tribal farmers fields in hilly areas, it is necessary that they should adopt the modern farming techniques.Hilly terrains was the major challenge faced during the study. In order to know the media preferences of tribal farmers residing in hilly areas, the present study was conducted in hilly district Reasi of Union Territory of Jammu and Kashmir which was selected purposively. A sample of 120 tribal farmers was selected randomly. A list of different sources of information was prepared and respondents were asked to indicate their preferences

on a three point scale. It was found that Extension Personnel of KVK, Extension Personnel of Agri.Deptt. and progressive tribal farmers were highly preferred by the respondents.

Effect of Chitosan and Gibberellic Acid on Flowering of Ornithogalum (*Ornithogalum thyrsoides*) Under Terai Region of West Bengal

Chaithra P.
Department of Floriculture, Medicinal and Aromatic Plants, Faculty of Horticulture, Uttar Banga Krishi Viswavidyalaya
Corresponding author's email id: chaithrap123moodal@gmail.com

Abstract

Ornithogalum (*Ornithogalum thyrsoides* Jacq.), a geophytic ornamental belonging to the Asparagaceae family, is valued for its attractive white flowers and is widely used as a cut flower, potted plant, garden ornamental and also in landscaping. This frost-tolerant bulbous ornamental is well suited to hilly and temperate regions, while its cultivation in the plains remains difficult. Adapting Ornithogalum to subtropical Terai plains may expand its cultivation, but short winters and long rainy periods reduce flower quality and hinder bulb harvesting. Chitosan like bio-stimulants may help in improving adaptation. Introducing this high-value flowering crop can offer a profitable alternative by expanding opportunities beyond conventional cultivation. Reducing its vegetative phase through bio-stimulants and Plant growth regulators (PGRs) can help to overcome these limitations. Among PGRs, Gibberellic acid enhances growth, development and early flowering in ornamentals. However, studies on its combined use with chitosan in bulbous ornamentals, especially Ornithogalum are limited. The present study was conducted at the Instructional Farm, Department of Floriculture, Medicinal and Aromatic Plants, Uttar Banga Krishi Viswavidyalaya, West Bengal, India. The experimental design consists of 10 treatments including Chitosan (1.5% nano, high, medium and low molecular weight grades) and GA_3 (0 & 100 ppm levels). The results suggested that T_8 (Chitosan Medium Molecular Weight (1.5%) + Gibberellic acid @100ppm) represented as most promising among the treatments as it showed best in number of days required for opening of 1st floret (145.37±3.71), number of days required for opening of last flower (159.27±3.20), number of inflorescence per plant (5.7±0.73) and number of florets per inflorescence (20.03±4.41). However, T_6 (No Chitosan + Gibberellic acid @100ppm) showed best results in spike initiation (126.5±2.20) and number of days required for 1st floret maturity stage (140.07±4.01).

Keywords: *Ornithogalum thyrsoides, Asparagaceae, Chitosan, Bio-stimulant, Plant growth regulators, Gibberellic acid.*

Agronomic and molecular investigation of terminal heat and drought stress tolerance in bread wheat (*Triticum aestivum* L.)

Manu Mehra[1] and Dr. Girish Chandra Pandey[1]*
[1]Department of Bioscience and Biotechnology, Banasthali Vidyapith, Rajasthan, India
Corresponding author e-mail: girishchandrapandey@banasthali.in

Abstract

Wheat (*Triticum aestivum* L.) is one of the most important cereal crops globally and plays a crucial role in ensuring food and nutritional security. However, terminal heat and drought stresses have emerged as major constraints affecting wheat productivity, particularly during the reproductive and grain-filling stages. The present study aims to investigate agronomic, physiological and molecular responses associated with terminal heat and drought stress tolerance in bread wheat. Six wheat genotypes, namely C306, HD3386, DBW424, HD3059, DBW327 and DBW370, obtained from ICAR–Indian Institute of Wheat and Barley Research (IIWBR), Karnal, are being evaluated under field conditions at Krishi Vigyan Kendra, Banasthali Vidyapith, Tonk, Rajasthan, using three replications. Terminal heat stress is being imposed through late sowing, while drought stress is induced by withholding irrigation after three irrigations during the grain-filling stage. Agronomic traits including plant height, spike length, grain number per spike, grain weight per spike, grain number per plant, grain weight per plant, biomass per plant and thousand grain weight are being recorded. Physiological parameters such as canopy temperature, chlorophyll content, chlorophyll fluorescence and relative water content are also being assessed. For molecular characterization, genomic DNA is extracted using the CTAB method and genotyping is being carried out using approximately 200–250 SSR markers belonging to the GWM, BARC and WMC series. Marker–trait association analysis will be performed to identify molecular markers linked with stress-responsive traits. The study is expected to identify wheat genotypes with superior tolerance to terminal heat and drought stresses and to detect informative SSR markers associated with stress adaptation. The findings may contribute to the development of climate-resilient wheat cultivars and support marker-assisted breeding programmes aimed at enhancing wheat productivity under changing climatic conditions.

Keywords: *Bread wheat, Terminal heat stress, Drought stress, SSR markers, Marker–trait association, Climate resilience.*

Effect of Moisture Content on Stabilization Efficiency and Oil Quality of Rice Bran

Gaurav Kumar*[1], Nabaneeta Basak[1], P. Sanghamitra[2], Sutapa Sarkar[2]

[1]Crop Physiology and Biochemistry Division, [2]Crop Improvement Division

[3]Crop Improvement Division

ICAR-CRRI, Cuttack- 753006

**** Corresponding author. Email:gauraviari@yahoo.co.in***

Abstract

Rice bran is a nutritionally valuable by-product of rice milling, rich in oil and bioactive compounds such as ã-oryzanol. However, its utilization is limited by rapid rancidity caused by lipase activity immediately after milling, resulting in a very short shelf life. Therefore, effective stabilization techniques are essential to preserve rice bran quality and maximize oil recovery. The present study evaluated the effect of moisture content on the efficiency of microwave stabilization and the quality of rice bran oil (RBO). Fresh rice bran obtained from 35 rice varieties, including ICAR-CRRI varieties and other widely cultivated genotypes, was stabilized using microwave treatment (600 W for 30 seconds) at two moisture levels: normal-moisture bran (22%; M22 MW) and hot-air-dried bran (12%; M12 MW). Oil content, ã-

oryzanol concentration, acid value, and peroxide value were determined to assess stabilization efficiency and oil quality. The results revealed that hot-air-dried bran (M12 MW) yielded higher oil recovery than normal-moisture bran, primarily due to its lower moisture content. However, the stabilization treatment itself did not significantly influence oil extraction efficiency. In contrast, bran stabilized at normal moisture content exhibited superior oil quality characteristics. The average ã-oryzanol content was higher in M22 MW samples (1.90%) compared to M12 MW samples (1.74%), indicating better retention of bioactive compounds under normal-moisture conditions. Similarly, quality deterioration indicators were significantly lower in M22 MW samples. The average acid value and peroxide value of M22 MW bran were 0.28 mg g{ ¹ and 1.51 meq kg{ ¹, respectively, whereas corresponding values in M12 MW bran were 0.35 mg g{ ¹ and 1.92 meq kg{ ¹. The lower acid and peroxide values observed in normal-moisture bran indicate enhanced stabilization efficiency and improved oxidative stability of the extracted oil. The findings demonstrate that microwave stabilization is more effective when rice bran retains its natural moisture content, resulting in better preservation of oil quality and shelf-life attributes.

Keywords: Rice bran, Microwave stabilization, Moisture content, ã-Oryzanol, Oil quality

Impact of organic sources of nutrients on the growth performance, yield and production economics of summer rice *(Oryza sativa L.)*

Arghya Thakur[1], Mohammed Sulayman[1]*, Mausumi Rahman[1] and Nonigopal Shit[2]
[1]Department of Agronomy, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar 736165, West Bengal, India
[2]RRS-TZ, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, 736165, West Bengal, India
Corresponding author e-mail – sulaymanmd99@gmail.com

Abstract

An experiment was conducted in the experimental farm of Uttar Banga Krishi Viswavidyalaya, Cooch Behar, West Bengal during the period from January to May 2023 to study the effect of various combinations of organic manure and inorganic fertilizer on the growth, yield and production economics of summer rice *(cv.* MTU 1153*)*. The experiment was laid out in a randomized complete block design with three replications and seven treatments. Poultry manure (PM), vermicompost (VC) and Farm Yard manure (FYM) were organic sources of nutrients used in this study. The use of PM in conjunction with the recommended dose of fertilizer significantly impacted the morphological characteristics, yield-related factors and overall crop yield, specifically, when 25% of the recommended dose of fertilizer was replaced with poultry manure. In terms of grain and straw yield, this treatment performed better than the others, producing 6.12 tons ha^{-1} and 7.11 tons ha^{-1} respectively. Significant variation in N, P and K content of soil under various treatments observed after harvest of rice. The maximum soil available N, P and K were noticed with 75 % (N) by RDF + 25 % (N) substitute through PM. From an economic stand point, this treatment was the most profitable, yielding a net return of ¹ 69,538 and a benefit-cost ratio (B:C) of 2.19. From these findings, it can be concluded that the treatment involving 25% (N) substituted by PM exhibited the best response across growth, yield and production economics compared to all possible combinations of VC and FYM.

Keywords: *Organic fertilizer, Growth, Yield, Economics, Summer rice*

Integrated Effect of Enriched Compost and Foliar Spray of Humic Acid on Growth, Fasciculated Root Yield and Saponin Content of Safed Musli

Priya Dhayal[1*], A.B. Age[2], A.M. Magdum[3]
[1]Department of Soil Science, Indian Agricultural Research Institute, Kolkata Hub, Barrackpore, West Bengal-700121
[2] Department of Soil Science and Agricultural Chemistry, Dr Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra – 444104
[3] Department of Soil Science, Punjab Agricultural University, Ludhiana, Punjab-141004
***Corresponding Author: priyadhayaljobner@gmail.com**

Abstract

Safed Musli (*Chlorophytum borivilianum*) is an important medicinal root crop with high commercial value due to its saponin rich roots. Growing concerns over rising fertilizer costs, low fertilizer use efficiency, nutrient losses and environmental degradation have increased interest in organic nutrient management. Enriched compost offers a concentrated source of nutrients, improve fertilizer use efficiency, maintains soil organic matter, and reduces nutrient losses, while humic substances act as plant bio-stimulants by enhancing nutrient uptake, photosynthesis, leaf area, root development and overall plant growth. Therefore, the present study was undertaken to evaluate the effect of NPS enriched compost and foliar application of humic acid on the growth, yield and quality of Safed Musli. NPS enriched compost was prepared using wheat straw compost enriched with Gliricidia leaves, rock phosphate, elemental sulphur and PDKV decomposer. The experiment was laid out in a Randomized Block Design with nine treatments and three replications. Application of NPS enriched compost @ 4.5 t ha^{-1} along with two sprays of 0.5 % humic acid at 60 and 90 DAP recorded significantly higher number of leaves, leaf area and chlorophyll content at 45, 75 and 105 DAP. The treatment also produced the highest dry root yield and remained at par with NPS enriched compost @3.0 t ha^{-1} with two foliar sprays of 0.5 % humic acid. Both treatments were superior to the control and other treatments. The study indicated that integrated application of NPS enriched compost and humic acid effectively improved growth, yield and quality of Safed Musli.

Keywords*: NPS Enriched Compost, Humic Acid Spray, Chlorophyll Content, Leaf Area, Number of Leaves, fasciculated Root Yield, Saponin Content*

Formulation Optimization and Physicochemical Characterization of a Polymeric Matrix Transdermal Delivery System for Combined Herbal Antidiabetic Agents Using Response Surface Methodology

Shaikh Aatif Jameel Ahmed [1*], Sunita.S. Deore[2]
Department of Pharmaceutical sciences PhD Scholar, Sandip University, Nashik, Maharashtra, India 422001
Department of Pharmaceutical sciences Research Supervisor, Sandip University, Nashik, Maharashtra, India 422001
Correspondinding author email: atifpharma11@gmail.com

Abstract

Background: Diabetes mellitus represents a major global health challenge, with the International Diabetes Federation estimating 537 million affected adults worldwide and projections reaching 783 million by 2045. Oral antidiabetic therapies are limited by first-pass hepatic metabolism, gastrointestinal adverse effects, and variable patient compliance. Transdermal drug delivery systems circumvent these limitations by bypassing first-pass metabolism, maintaining steady plasma drug levels, and enabling sustained drug release. Objective: This study aimed to formulate and optimize a matrix-type antidiabetic herbal transdermal patch containing hydroalcoholic extracts of Gymnema sylvestre and Tinospora cordifolia using Box-Behnken design (BBD), and to comprehensively evaluate its physicochemical properties, in-vitro drug release, release kinetics, and stability. Methods: Hydroalcoholic extracts of G. sylvestre (leaves) and T. cordifolia (stems) were prepared by Soxhlet extraction and characterized through phytochemical screening, fluorescence analysis, and identity/purity/strength parameters. Drug-excipient compatibility was assessed via FTIR and DSC. A three-factor, three-level BBD was applied with PVA concentration (30–70%), ethanol concentration (20–50%), and drying time (12–36 h) as independent variables. Fifteen formulations were prepared by solvent casting using PVA, HPMC, and chitosan as polymers, with PEG 400, glycerol, DMSO, and Tween 80 as excipients. Patches were evaluated for thickness, folding endurance, tensile strength, moisture uptake, water vapour transmission rate, surface pH, drug content, in-vitro drug release (Franz diffusion cell), and release kinetics (zero-order, first-order, Higuchi, Korsmeyer-Peppas, Hixson-Crowell). Stability studies were conducted at 25°C/60% RH and 40°C/75% RH for 60 days per ICH Q1A(R2) guidelines.

Results: Phytochemical screening confirmed alkaloids, glycosides, flavonoids, saponins, steroids, and tannins in both extracts. FTIR and DSC verified drug-excipient compatibility with no significant peak shifts or new thermal events. The optimized formulation (Run 14: PVA 70%, ethanol 35%, drying 36 h) exhibited thickness 0.38±0.01 mm, folding endurance >140, tensile strength 3.80±0.16 kg/cm², drug content 99.1±0.7%, and cumulative drug release of 96.2±1.5% over 24 h. Drug release followed zero-order kinetics (R^2=0.981, K• =3.998 %/h) with a Korsmeyer-Peppas exponent of n=0.62, indicating non-Fickian (anomalous) transport governed by both diffusion and polymer relaxation. The optimized formulation significantly outperformed the non-optimized formulation (Run 11) in tensile strength (3.80 vs 2.92 kg/cm²), drug content (99.1 vs 92.4%), and cumulative release (96.2 vs 84.3%). Stability studies showed no significant changes in drug content or release profile under either storage condition over 60 days.

Conclusion: The BBD-optimized herbal transdermal patch demonstrated excellent physicochemical properties, sustained zero-order drug release via non-Fickian transport, and good stability under ICH-recommended conditions, supporting its potential as an effective transdermal alternative to oral antidiabetic therapy. Further in-vivo pharmacological evaluation is warranted to confirm antidiabetic efficacy and pharmacokinetic advantages.

Keywords: *Box-Behnken design; response surface methodology; matrix transdermal patch; herbal antidiabetic; zero-order release kinetics; non-Fickian transport; physicochemical evaluation; solvent casting; drug-excipient compatibility; stability studies*

Effect of different edible coatings on quality attributes of Ber (*Ziziphus mauritiana* Lamk.) cv. Apple Ber under Ambient Storage Conditions.

Sumit[1*], Satpal Baloda[2] and Sakshi[3]
[1*3]PhD Scholar, Department of Horticulture, CCSHAU, Hisar
[2]Assistant Scientist, Department of Horticulture, CCSHAU, Hisar
E-mail: sumitkaleramna@gmail.com

Abstract

The present investigation was conducted in the Field Laboratory and Postharvest Technology Laboratory, Department of Horticulture, CCS Haryana Agricultural University, Hisar, Haryana, to evaluate the effectiveness of different edible coatings on the postharvest quality and storage behaviour of ber fruits under ambient room temperature conditions. The experiment comprised ten treatments, including turmeric extract (10 and 20%), chitosan (1.5 and 2.0%), guar gum (1 and 2%), aloe vera extract, lemongrass oil (0.1 and 0.2%) and an untreated control. Fruits were evaluated at 0, 3, 6, 9 and 12 days of storage for fruit colour, organoleptic quality, total soluble solids (TSS), total sugars, reducing sugars and non-reducing sugars. The results revealed significant effects of edible coatings on all quality parameters during storage. Fruit colour and organoleptic quality declined progressively with advancement of storage; however, coated fruits exhibited a slower rate of deterioration than untreated fruits. Among all treatments, aloe vera extract (T7) proved most effective in maintaining fruit colour and sensory quality, recording the highest mean fruit colour scores (3.86 and 3.95) and organoleptic quality scores (7.92 and 7.96). Chitosan at 2.0% (T4) also performed comparably and significantly better than the control. Total soluble solids, total sugars, reducing sugars and non-reducing sugars increased up to the ninth day of storage, followed by a decline at the end of the storage period. Aloe vera-coated fruits recorded the highest mean TSS (14.36 and 14.56 °Brix), total sugars (10.14 and 10.28%), reducing sugars (4.28 and 4.35%) and non-reducing sugars (5.56 and 5.63%) during the respective years. In contrast, untreated fruits showed the lowest values for most quality attributes and experienced the fastest deterioration.

Keywords- *Ber, Fruit Color, Organoleptic Quality, TSS, Sugar.*

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