Abstract Book for

11th NATIONAL CONFERENCE

FutureAg-2025

"ADVANCING FOOD & FARMING FOR SUSTAINABLE FUTURE"

Organized by:

Dept. of Agriculture, Suresh Gyan Vihar University, Jaipur (ICAR Accredited)

in collaboration with Just Agriculture Communications Group & ISAHRD Society

on **9th -10th September, 2025**

at **Suresh Gyan Vihar University, Jaipur, Rajasthan**

Editors:

Dr. Sushila Hooda

Dr. D. P. S. Badwal

JUST AGRICULTURE PUBLICATIONS

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Prof. Balraj Singh
Vice-Chancellor

Message

It gives me immense pleasure to learn that the **11th National Conference –** *FutureAg-2025* **on "Advancing Food & Farming for Sustainable Future"** is being organized by the **Department of Agriculture, Suresh Gyan Vihar University, Jaipur (ICAR Accredited)** in collaboration with the Just Agriculture Communications Group on 9th - 10th September, 2025 at Suresh Gyan Vihar University, Jaipur, Rajasthan.

This conference will serve as a dynamic platform for researchers, academicians, industry experts, and students to deliberate on innovative approaches, sustainable practices and future-ready solutions for strengthening Indian agriculture. The chosen theme is highly relevant in the present scenario where food security, climate resilience and sustainable farming systems are of paramount importance.

I am confident that the deliberations and knowledge exchange during this event will contribute significantly to advancing agricultural science and practices, ultimately fostering a more sustainable and resilient food system for our nation.

I extend my best wishes to the organizers, collaborators and participants for the grand success of *FutureAg-2025*.

(Balraj Singh)

डॉ. ज्ञानेन्द्र प्रताप सिंह, पी.एच.डी.
निदेशक
Dr. Gyanendra Pratap Singh, Ph.D
Director

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Message

It is a matter of great pride to be associated with the 11th National Conference – *FutureAg-2025* on "Advancing Food & Farming for Sustainable Future", organized by the Department of Agriculture, Suresh Gyan Vihar University, Jaipur (ICAR Accredited) in collaboration with the Just Agriculture Communications Group and the ISAHRD Society is scheduled on 9th - 10th September, 2025 at Jaipur, Rajasthan.

The theme of this conference is timely and highly significant as it focuses on strengthening food security, promoting sustainable farming practices and preparing agriculture for the challenges of the future. Such academic and professional gatherings provide an excellent opportunity for researchers, educators, students and practitioners to exchange innovative ideas and share research insights that can shape the future of Indian agriculture.

I firmly believe that the deliberations during this conference will pave the way for constructive solutions to address current agricultural challenges, foster innovation and contribute towards a sustainable and resilient farming system.

I extend my heartfelt congratulations to the organizers and collaborators for their dedicated efforts in convening this important event and I wish *FutureAg-2025* grand success.

(Dr. Gyanendra Pratap Singh)

MESSAGE FROM CONFERENCE DIRECTOR

The development and adoption of innovative technologies have been instrumental in improving the lives of millions of farmers across the country by increasing their income, reducing their costs and minimizing losses. As agriculture continues to evolve, the role of innovation will become even more critical in enhancing sustainability, resilience, and competitiveness in the sector. Keeping these facts in mind 11th National Conference FutureAg-2025 on "Advancing Food & Farming for Sustainable Future" was planned by Just Agriculture Communications Group & ISAHRD Society in collaboration with Dept. of Agriculture, Suresh Gyan Vihar University, Jaipur (ICAR Accredited) during 9th -10th September, 2025. The conference was embellished by the presence of Chief Guest, Prof. (Dr.) Balraj Singh, Vice- Chancellor, SKNAU, Jobner.

The conference was a great platform for professionals and experts from different industries to come together, exchange ideas, and explore new opportunities. The keynote speakers and panelists provided valuable insights on a range of topics, from the latest developments in technology and innovation to the challenges facing businesses in a rapidly changing world. The success of this conference would not have been possible without the hard work and dedication of our organizing committee and volunteers. We are grateful for their support and contributions towards making this event such a huge success. Thank you to all the attendees for making this a memorable and enriching experience. We look forward to seeing you again at our future events, where we will continue to bring together the best minds in the industry and create valuable opportunities for learning and growth.

Dr. DPS Badwal
Founder & CEO,
Just Agriculture Communications Group

MESSAGE FROM SOCIETY PRESIDENT

It gives me immense pleasure to share that ISAHRDS Society and Just Agriculture Communications Group in collaboration with Dept. of Agriculture, Suresh Gyan Vihar University, Jaipur (ICAR Accredited) have successfully organized the 11th National Conference FutureAg-2025 on "Advancing Food & Farming for Sustainable Future" at Suresh Gyan Vihar University, Jaipur during 9th -10th September, 2025. in a hybrid mode. I believe that this conference has played an important role in bringing together experts, researchers and practitioners from across the world to exchange ideas, share their experiences and contribute towards the development of the agriculture sector. We have witnessed several innovative approaches, emerging technologies and sustainable practices that have the potential to revolutionize the agriculture sector and create a positive impact on our environment and economy.

The conference has also highlighted the significance of collaboration among different stakeholders including government, academia, industry and farmers. Through constructive discussions, we have identified the key challenges faced by the agriculture sector and the possible solutions to address them. In conclusion, I would like to congratulate the organizing team for the successful organization of the 11th National Conference FutureAg-2025. We look forward to the next edition of this conference and hope to witness more innovative ideas and practices in the field of agriculture. Thank you all for your participation and support.

Dr. Sushila Hooda
Vice-President
Just Agriculture Communications Group

BOOK OF ABSTRACTS

11th NATIONAL CONFERENCE
on

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"Advancing Food & Farming for Sustainable Future"

9th – 10th September, 2025

ISBN: 978-93-344-1457-8 FA/2025/001

Extent of utilization of ICTs by farmers

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Senior Scientist and Head, KVK, Periyavaram[2]

Director of Extension, Dr.YSRHU[3]

ICT in the agriculture sector facilitates knowledge sharing within and among a variety of agriculture networks including researchers, exporters, extension services and farmers. ICT enables vital information flows by linking rural agricultural communities to the internet, both in terms of accessing information and providing local content. The present investigation was carried out in Tirupati district of Andhra Pradesh. The study was conducted in Venkatagiri, Balayapalle and Dakkili mandals taking 2 villages from each mandal. From these villages twenty farmers each village were selected making a total sample size of 120 farmers. The data were collected personally by using the structured interview schedule. Findings of the study revealed that Television was used frequently for information seeking pertaining to inputs availability and prices (18.33%), Weather forecasting (84.17%), Soil Health Management (15.83%), Pest and Disease management (36.67%), Market information (21.67%), credit and finance information (23.33%) and Government schemes (61.67%). Mobile phones were used frequently for information seeking pertaining to inputs availability and prices (9.17%), Weather forecasting (35.00%), Pest and Disease management (7.50%), Market information (9.17%), credit and finance information (8.33%) and Government schemes (1.67%). More than half of the farmers were using Youtube (55.83 per cent), Whatsapp (54.16 per cent), Facebook (50.83 per cent).

ISBN: 978-93-344-1457-8 FA/2025/002

Sustainable Synergies: Integrated farming with Sericulture

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Integrated Farming System (IFS) has emerged as a sustainable approach to agriculture, balancing productivity with environmental conservation. This review examines the role of IFS in minimizing environmental impact through the integration of crop cultivation, livestock, aquaculture, agroforestry and sericulture. By fostering synergies among these components, IFS optimizes resource use, reduces waste, and mitigates ecological degradation. Key benefits include enhanced soil fertility through organic matter recycling, reduced reliance on chemical fertilizer, and lower greenhouse gas emission via efficient nutrient recycling. Crop-livestock integration, for instance, utilizes manure as a natural fertilizer, while agroforestry sequesters carbon and prevents soil erosion. Water management is improved through techniques like rainwater harvesting, minimizing runoff and preserving aquatic ecosystems. Despite these advantages, challenges such as high initial cost, knowledge gaps, and regional adaptability limit widespread adoption. Recent studies highlight the need for farmers training, and technological innovations to scale IFS effectively. This review synthesizes evidence from case studies, demonstrating that IFS can significantly reduce agriculture's environmental footprint while ensuring food security. By aligning economic viability with ecological resilience, IFS offers a promising pathway to sustainable agriculture, addressing pressing environmental concerns in the face of climate change and resource depletion.

Keywords: Integration, Sustainability, Ecosystem, Climate change

ISBN: 978-93-344-1457-8 FA/2025/003

CLIMATE CHANGE AND SIMULATIONS

Impact of Climate Change on Fruiting Behavior and Productivity of Fruit Crops for Sustainable Horticulture

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With its varied agro-climatic regions, India is one of the biggest fruit producers including mango, banana, citrus, guava, grape, apple, and pomegranate. These are crops that are crucial in nutritional security, livelihood of farmers and export income. Their yield is, however, very sensitive to variations in climate because flowering, fruit set and maturation are all very much controlled according to the temperature, rainfall, and humidity patterns. Continuous climate change with increasing temperatures, erratic monsoons, extended droughts, unseasonal rainfall, and frost incidents is making fruiting behavior and yield stability progressively disrupted. According to scientific findings, low chilling of temperate fruits such as apple and pear is lowering productivity in Himachal Pradesh and Jammu and Kashmir forcing farmers to grow in high altitudes. In belts of Uttar Pradesh, Gujarat and Andhra Pradesh where mangoes are grown, high temperatures and untimely rains during flowering and development of the fruits result in poor fruit set, excessive fruit drop, and loss of yields. On the same note, Maharashtra citrus and grape orchards usually experience irregular bearing, lessening berry size, and quality under mixed heat and water stress. Such effects are mainly attributed to altered carbohydrate metabolism, hormonal distortions, inefficiency of pollination, and stress induced abscission. These are development of climate-resistant cultivars, planting of dense orchards with canopy control to control microclimate, implementation of micro-irrigation and fertilizer regimes, use of plant growth regulators to stabilize fruit set, and covered cultivation in problematic areas. Moreover, there is the promotion of ICT based weather forecasting, crop simulation models and precision orchard management tools to increase resilience and better decision-making among the farmers. Advancing climate-smart horticultural practices is, therefore, a key pathway to ensure sustainable fruit production and long-term food and nutritional security.

Key words: Climate change, Fruit crops, Productivity, Sustainable horticulture

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Enhancing Salt Resilience in Tomato through Integrated Approaches

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Tomato (*Solanum lycopersicum L.*), a globally important vegetable crop, is highly sensitive to salinity stress, which represents one of the most serious abiotic constraints limiting its productivity, especially in arid and semi-arid regions where irrigation with saline water is common. High salt concentrations in soil or irrigation water cause osmotic stress, ionic toxicity, and nutrient imbalance, thereby impairing germination, photosynthesis, water uptake, and reproductive processes. Prolonged salinity stress leads to reduced growth, yield losses, and poor fruit quality due to disruptions in metabolic and physiological Functions. Tomato plants adopt multiple tolerance mechanisms to mitigate salinity effects. Morphological and physiological responses include reduced stomatal conductance, maintenance of turgor through osmotic adjustment, selective uptake or exclusion of Na^+ And Cl^- ions, and improved water use efficiency. At the biochemical level, tomatoes accumulate compatible osmolytes such as proline, glycine betaine, soluble sugars, and polyols, which stabilize proteins and membranes under stress. Enhanced activity of antioxidant enzymes like superoxide dismutase, catalase, and peroxidases also protects against oxidative damage caused by reactive oxygen species. Marker-assisted breeding, quantitative trait loci (QTL) mapping, and transgenic approaches have contributed to developing tolerant genotypes, while CRISPR/Cas9 genome editing offers precise opportunities for engineering salt-resilient tomatoes. Additionally, agronomic practices such as the application of bio-stimulants, beneficial microbes (PGPR, mycorrhizae), grafting onto salt-tolerant rootstocks, and efficient irrigation management strategies provide practical solutions to alleviate salinity effects. An integrated approach combining molecular breeding, biotechnology, and sustainable crop management practices is essential to enhance salinity tolerance in tomato. Strengthening such strategies will not only secure tomato productivity under saline conditions but also contribute to global food security and the sustainability of vegetable production systems under climate change scenarios.

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Advanced Remote Sensing Techniques for Cropland Monitoring using the AquaCrop

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This study evaluates the influence of different mulching practices and irrigation regimes on chickpea (*Cicer arietinum L.*) yield, water use efficiency (WUE), and the performance of the AquaCrop model for simulating crop responses. Eight treatment combinations were tested under a factorial randomized block design, involving two irrigation schedules (single and double) and four mulch types: biodegradable mulch (BDM), non-woven mulch (NWM), black polyethylene mulch (BPM), and no mulch (NM). Results revealed significant effects of mulching and irrigation on crop growth and productivity, with the BDM + single irrigation treatment achieving the highest grain yield (26.49 q/ha), maximum WUE (182.7 kg/ha- cm), and superior economic returns. The AquaCrop model was calibrated using canopy cover, biomass, and yield data from the control treatment (full irrigation without mulch). The model showed strong agreement with observed data (R^2NS > 0.90), though with moderate overestimation (negative CRM). Validation across remaining treatments confirmed its robustness in simulating biomass and yield under varying soil moisture conservation strategies. The findings underscore the potential of integrating biodegradable mulches with optimized irrigation scheduling to improve chickpea productivity and resource use efficiency. Moreover, the AquaCrop model demonstrates high reliability as a decision-support tool for assessing and monitoring conservation practices in semi-arid cropping systems, with relevance for precision agriculture and remote sensing applications.

Keywords: Chickpea, Mulching, Irrigation scheduling, Water use efficiency, AquaCrop model

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Climate-Smart Farming Systems for Sustainable Agriculture and Resilience

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Agriculture is one of the sectors most vulnerable to climate change, as farmers across the world are experiencing unpredictable rainfall, rising temperatures, soil degradation, and frequent natural disasters such as floods and droughts. These changes not only threaten crop yields and food supply but also put pressure on water resources, soil health, and rural livelihoods. To overcome these challenges, climate-smart farming systems have been introduced as an innovative and sustainable approach to agriculture. The main objectives of climate-smart farming are threefold: to sustainably increase productivity, to help farmers adapt to climate variability, and to reduce greenhouse gas emissions from agricultural practices. This means producing more food in ways that are friendly to the environment and supportive of long-term food security. Examples of such practices include crop diversification, agroforestry, conservation tillage, integrated nutrient and water management, and organic farming techniques. These methods not only improve resilience to climate shocks but also enhance soil fertility, conserve water, and reduce dependency on chemical inputs. In addition to traditional techniques, modern innovations play a key role in climate-smart farming. Renewable energy technologies, such as solar pumps and biogas units, also help reduce carbon emissions while lowering energy costs. Climate-smart farming systems combine traditional wisdom with scientific innovation, making them practical and adaptable for both small-scale and large-scale farmers. By adopting these methods, communities can secure their food supply, protect natural resources, and build resilience against future climate risks. Ultimately, climate-smart farming offers a pathway to achieve sustainable agriculture while contributing to broader goals of environmental protection, rural development, and climate change mitigation.

Key words: Climate-smart farming, Sustainable agriculture, Food security, Crop diversification, Agroforestry, Precision agriculture, Climate resilience

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EFFICACY OF NOVEL FUNGICIDE AZOXYSTROBIN AGAINST FALSE SMUT IN PADDY

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Paddy is the major agricultural crop cultivated in Krishna district, Andhra Pradesh in an area of 1.37 lakh ha and with productivity of 5958 kg ha -1 (Andhra Pradesh Agricultural Statistics at a glance, 2022-23). Among the various biotic stresses affecting the yield, diseases like sheath blight, stem rot and false smut were found to be predominant in Krishna district and estimated yield loss is around 35 per cent by false smut, if proper plant protection measures were not adopted. Keeping in this view, a front line demonstration was conducted in five locations during kharif, 2024 in farmers fields (Tadepalli, Merakanapalli, Nimmagadda, Bodagunta and Tarakaturu villages covering Ghantasala, Challapalli, Mopidevi and Guduru mandals) with practices like seed treatment with *Pseudomonas fluorescens* @ 10 gm per kg of seed and two sprayings of Azoxystrobin @ 1.0 ml l -1 at booting stage followed by Propiconazole @ 1.0 ml l -1 at seven days interval. The results revealed that the incidence of false smut was 8.84 per cent in treated plots as against 13.62 per cent in farmers field with 35.1 per cent reduction of disease over farmers practice. Further, the yield and BC ratio with respect to treated plot and farmers practice was found to be 6712.5 kg ha -1 and 6243.8 5 kg ha -1 , respectively, with 2.07: 1and 1.68:1 BCR, respectively. An average yield of 7.5 % (468.7 kg ha -1) was recorded over farmer practice. Hence, the novel fungicide azoxystrobin may be suggested to farmers in view of moderate to severe incidence of false smut in paddy.

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Multidrug-Resistant Escherichia coli in Captive Wild Herbivores of Chhattisgarh

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Prevalence of antimicrobial-resistant bacteria due to the indiscriminate use of antimicrobials across diverse ecosystems has become a significant global concern. In the present study, a total of 67 fecal samples collected from captive wild herbivores housed in three different zoos were processed for the isolation of Escherichia coli. All presumptive E. coli isolates were confirmed by amplification of the 16S rRNA gene. Antibiogram analysis of the isolates revealed the highest sensitivity to norfloxacin (64.17%), while the highest resistance was observed against amoxicillin and tetracycline (74.63% each). Notably, none of the E. coli isolates from deer, sambar, blackbuck, and nilgai showed sensitivity to tetracycline, underscoring a critical resistance concern. The Multiple Antibiotic Resistance (MAR) index ranged from 0.11 to 0.78, with one isolate exhibiting the highest MAR index of 0.78. Phenotypic screening using ESBL agar indicated that 36 isolates (53.73%) were presumptive ESBL producers. Molecular characterization revealed that 13 isolates (36.11%) harbored the blaTEM gene, while 6 isolates (16.66%) carried the blaCTX-M gene. The blaSHV gene was detected in only 2 isolates (5.5%). These findings highlight the significant prevalence of multidrug-resistant and ESBL-producing E. coli in captive wild herbivores, indicating their potential role as reservoirs for antimicrobial resistance transmission within animal populations and possibly across the human-animal- environment interface. This underscores the urgent need for a comprehensive One Health approach to manage and mitigate antimicrobial resistance risks.

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CRISPR-Cas9: A Genome Editing Approach for Improving Drought and Salinity

Tolerance in Rice

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Rice (*Oryza sativa L.*) is a staple food crop that sustains more than half of the global population. However, its productivity is severely threatened by abiotic stresses such as drought and salinity, which are increasingly prevalent under changing climatic conditions. Conventional breeding and transgenic approaches have contributed to developing stress-tolerant varieties, but these strategies are often limited by long breeding cycles, linkage drag, and regulatory concerns. CRISPR-Cas9 enables the knockout or fine-tuning of key stress-responsive genes, including transcription factors (OsNAC, OsMYB, OsDREB), ABA signaling components (OsPP2C, OsPYL, OsSAPK), and ion transporters such as OsHKT1;5, OsNHX1, and OsSOS1, which play critical roles in maintaining cellular homeostasis under drought and salinity stress. Successful applications include editing of OsRR22 for enhanced tolerance to both stresses, modification of OsDST to regulate stomatal density and water-use efficiency, and multiplex targeting of ion transporter genes to improve Na^+/K^+ balance in saline soils. Emerging tools like base editing and prime editing further enhance the scope of introducing precise point mutations for fine-tuning stress responses. Integration of CRISPR-Cas9 with speed breeding, omics technologies, and marker-assisted selection will accelerate the development of climate-resilient rice varieties. This review emphasizes the transformative potential of CRISPR-Cas9 as a genome editing platform for enhancing drought and salinity tolerance in rice.

Key words: CRISPR-Cas9, Rice, Drought tolerance, Salinity Tolerance, stress responsive Genes

ISBN: 978-93-344-1457-8 **FA/2025/010**

Line x tester analysis for combining ability in Indian mustard [*Brassica juncea (L.) Czern Coss*]

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Line × tester analysis was carried out to estimate combining ability of 36 hybrids developed by crossing 9 lines with 4 testers of Indian mustard. Estimates of GCA effects indicated that Kranti, RH-749, Pusa Mustard-30 and Pusa Mahak and Tester, PM-27 were good general combiner. Significant SCA effects for seed yield per plant and other attributing traits in desirable direction were recorded in a series of hybrids and a close association between SCA effects and heterosis was observed amongst the best hybrids identified on the basis of SCA effects. The three hybrids; PM- 30 x CS 54, NRCHB 101 x PM 27, RH 749 x JM 1, IC- 597889 x JM-1 and RH-30 x CS-54 exhibited highly significant SCA effects and higher per se performance for seed yield and important traits. The high yielding cross combinations can be further exploited for improving the seed yield by development superior genotypes.

Keywords: General combining ability, Indian mustard, line x tester, specific combining ability

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Management of Fall Armyworm Spodoptera frujiperda in Maize

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Fall Armyworm Spodoptera frujiperda (J.E. Smith) (Lepidoptera: Noctuidae), is a polyphagous pest which is arising as one of the major threats to agriculture. This pest was first discovered in Africa (2016) and first detected on the Indian subcontinent in May 2018 in Maize fields at Karnataka. The ICAR National Bureau of Agricultural insect Resources, Bangalore has reported the damage intensity of FAW as 9 To 62% with the yield loss of 34% in Karnataka. First instar larvae serape leaves and show pin hole symptoms and window pane feeding symptoms whereas in the later vegetative stages, damage results in skeletonized leaves. If Climate condition for pest establishment is suitable this pest could cause approximately 100% crop loss in maize, if not managed in time, fall army worm bane back in Bihar's maize growing district, Khagaria, Begusarai, Samastipur, Madhepura, Purnea, Bhagalpur and Saharsa. Keeping in view incidence occurrence an OFT has been designed and conducted in different location at KVK, Khagaria in the year 2021 & 2022 in Rabi Maize for the management of FAW by the technological option -01 in which application of sand in whorl and at 5% damage symptoms, after 5 days application of sand spraying of Emanating benzoate 5sc@0.4 gm/lit of water and after 15 days of 1st spraying, application of Thiomethoxam 12.6% + Lambda cyhalothrin 9.5%@0.5 ml/lit of water. In technology option-02, application of soil in whorl, after 5 days 1st spraying with Fipronil 5 sc@ ml/lit and after 15 days, 2nd spraying with spinosad @ 0.2 ml/lit of water. In the farmers' practices, application of carbofuran (dose varied from farmer to farmer) against FAW under different management practices in Maize. Both the technological options (01&02) were found superior to farmer practices in reducing the incidence percent of FAW. To-1 gave better results in reducing the incidence percent (0.16), grain yield 84.70 q/ha during 2021 and during 2022 incidence percent (0.16), grain yield 79.14 q/ha. In terms of incremental cost benefit ratio (ICBR), it gave a fairly high ratio (1:2.69). Thus TO-1 was found to be more effective than others.

Key word: Corn, Incidence, Management, Spodoptera frujiperda

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Bio-Organo Silicon Granules for Salinity Tolerance and Higher Productivity in Tomato

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Silicon (Si) amendments are well known to mitigate salinity stress in tomato (*Solanum lycopersicum*), but higher doses can result in soil fixation and associated environmental concerns. To address these challenges, we developed and evaluated a bio-organo silicon granule (BOSG) strategy that integrates silicate-solubilizing bacteria (SSB), a chemical source, and an organic carrier to alleviate salt stress. Adsorption–desorption assays in a characterized saline soil revealed substantial Si fixation once solution concentrations exceeded ~100 ppm, with pronounced hysteresis, indicating low reversibility and minimal carryover from soluble sources. Preliminary pot screening (0–200 ppm) identified ~75 ppm solution Si as an operationally efficient dose, with diminishing physiological benefits at higher levels, consistent with fixation constraints. Soil incubation over 80 days showed sustained Si delivery for approximately 60 days, followed by a gradual decline; a power-function model provided the best kinetic fit (median $R^2 = 0.95–0.98$; $\Delta AIC \geq 12$ vs. zero- or first-order models). In saline pot trials, BOSG@100 kg si ha -1 significantly outperformed NPK-only controls: soil-solution Si increased by 20–35%, leaf Na^+ content decreased by 10–18 %, and physiological indices improved (chlorophyll +8–15%, photosynthetic rate + 10–14 %, membrane stability +6–12 %), leading to biomass and marketable yield gains of 12–22 %. Overall, these findings demonstrate that saline soils strongly immobilize Si above ~100 ppm, that ~75 ppm solution Si maximizes efficiency in this soil–crop system, and that SSB- enabled BOSG @100 kg Si ha -1 offers a lower-input, sustained-release strategy to mitigate salinity stress in tomato, meriting field-scale evaluation.

Keywords: Silicate-solubilizing bacteria; Salinity tolerance; Adsorption–desorption;

Release kinetics; Bio-Organo Silicon Granules.

ISBN: 978-93-344-1457-8 FA/2025/013

Optimizing Plant Density for Enhanced productivity of Yardlong Bean (*Vigna unguiculata subsp. sesquipedalis*) Under Protected Cultivation

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The cultivation of underutilized nutritionally rich vegetable yardlongbean is becoming popular under protected cultivation but there are no standardised agro-techniques in underutilized vegetable crops. Hence, the present investigation was undertaken to optimizing plant density to enhance the productivity of yardlong beans. The experiment involves eight spacing treatments (45x30 cm, 45x45 cm, 45x60 cm, 45x75 cm, 60x30 cm, 60x45 cm, 60x60 cm, 60x75 cm) with three replications. The results showed that all the attributes were significantly affected by different spacing. Two season pooled data result revealed that the 60x75 cm was significantly increased number of branches (11.33), pod yield per plant (599.08 g), pod length (74.60 cm), pod girth (4.09 cm), average pod weight (33.71 g) and number of pods per plant (23.98). But significantly highest pod yield 2050.71 kg/1000 m 2 was recorded with the 45x30 cm spacing and the lowest pod yield of 1272.09 kg/1000 m 2 recorded with the 60x75 cm spacing. Hence, the following spacing of 45x30 cm in cultivation of Yardlong bean recorded higher productivity (2050.71 kg/1000 m 2) and profitability B:C (2.19) under protected cultivation.

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Urban Floriculture: Rooftop and Terrace Gardening for Sustainable Cities

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Rapid urbanization has significantly reduced green spaces in cities, resulting in ecological imbalance, elevated temperatures, air pollution and loss of biodiversity. Therefore, urban floriculture through rooftop and terrace gardening emerges as a viable strategy for sustainable cities, combining ecological, social and economic advantages while addressing pressing issues of urbanization and climate change. In this context, rooftop and terrace gardening through floriculture has emerged as an innovative and sustainable approach to urban greening. By utilizing underused urban spaces, rooftop floriculture not only enhances city aesthetics but also provides critical ecosystem services such as microclimate regulation, urban heat island mitigation, air purification, carbon sequestration and stormwater management. Rooftop and terrace gardening through floriculture offers a sustainable solution to these challenges by transforming unused spaces into productive and aesthetically appealing green areas. Rooftop floriculture not only enhances the visual appeal of cities but also contributes to climate resilience by mitigating the urban heat island effect, improving air quality, conserving energy and supporting biodiversity. Despite challenges such as structural limitations, high installation costs and limited technical awareness, successful case studies across India and other countries demonstrate its feasibility and long-term benefits. Recent research highlights the potential of lightweight substrates, drip irrigation, hydroponics and vertical floral structures as practical solutions for space-constrained and water-scarce urban areas. Case studies from Indian cities such as Hyderabad, Bengaluru and Delhi have shown positive impacts of rooftop gardening and terrace gardening initiatives, including increased urban greenery, improved air quality and enhanced community participation. Therefore, rooftop and terrace floriculture should be promoted not only as an aesthetic intervention but also as a strategic response to climate change, urban food and flower demand and ecological restoration in rapidly urbanizing cities.

Keywords: Urbanization, Rooftop gardening, Terrace gardening and Climate change.

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"IMPROVING THE GROWTH AND FLOWER YIELD OF POT MARIGOLD (*CALENDULA OFFICINALIS L.*) UNDER VARIED WATER STRESS CONDITIONS USING BIO INOCULANTS"

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Water stress is a critical abiotic factor limiting crop productivity in arid and semi-arid regions. The present study aimed to assess the influence of bio-inoculants on growth, water relations, plant pigments, and flower yield of Pot marigold (*Calendula officinalis L.*) under varied water stress regimes, and to explore their potential in reducing irrigation frequency. A field experiment was conducted during 2020–2021 in a split plot design with four water regimes WS1 (field capacity), WS2 (75% field capacity), WS3 (50% field capacity), and WS4 (25% field capacity)— as main plots, and three bio-inoculants—AMF (Arbuscular mycorrhiza fungi), AMC (Arka microbial consortium), and control—as subplots, replicated thrice. The variety "Bon Bon Orange" was evaluated, and observations were recorded at 15, 30, 45, and 60 days after planting (DAP). Results indicated that WS2 produced the tallest plants (15.56 cm at 60 DAP), while AMF inoculation enhanced leaf dry mass (2.98 g at 30 DAP), leaf area index (17.41 cm2/g at 45 DAP), and leaf area duration. Higher relative water content was maintained in WS1 (66.91% at 45 DAP) and AMF (64.9%), whereas electrolyte leakage was lowest in WS2 × AMF (230.87 dSm). WS2 and AMF treatments significantly improved chlorophyll-a content and SPAD values, with WS2 × AMF recording the maximum chlorophyll-a (1.589 mg). Flower yield was highest in WS2 (39.33–56.67 flowers/plant) and AMF (38.25–57 flowers/plant). WS1 produced the greatest fresh biomass, while WS2 and AMF enhanced dry mass. Overall, WS2 (75% field capacity) in combination with AMF (20 g/plant) was most effective in improving growth, physiological traits, and yield of pot marigold, providing a sustainable strategy for optimizing production under limited irrigation conditions.

Key words: Water stress, Bio-inoculants, Calendula officinalis, Arbuscular mycorrhiza fungi (AMF), Flower yield

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Effect of hot-dry and hot-humid seasons on the plasma cytokines, hormones, and body surface temperatures in lactating indigenous (Sahiwal) and crossbred (Karan Fries) cows raised in tropical climates

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Heat stress (HS) significantly challenges dairy cattle, affecting their immune function, endocrine responses, and thermoregulation. This study investigated cytokine responses, hormonal changes, and body surface temperature variations in 12 indigenous Sahiwal (SW) and 12 crossbred Karan Fries (KF) cows reared under hot-dry (HD; THI=77.75) and hot- humid (HH; THI=81.48) seasons. Plasma concentrations of Interleukin-6 (IL-10), tumor necrosis factor-α (TNF-α), Interleukin-6 (IL-6), Interleukin-1β (IL-1β), cortisol, triiodothyronine (T3), and thyroxine (T4) were analysed using ELISA, while body surface temperatures were measured using infrared thermography (IRT). Significant ($P< 0.05$) variations were observed between breeds and across the two seasons. Higher TNF-α, IL-6, IL-1β, and cortisol levels were observed under HH compared to HD seasons. TNF-α levels increased significantly ($P < 0.05$) by 31.76% in SW and 36.47% in KF cows, while cortisol levels rose by 44.41% and 47.42%, respectively, from the HD to HH season. In contrast, T3 and T4 levels declined significantly ($P < 0.05$) by 25.60% and 36.42%, respectively, under HH seasons, with a greater reduction observed in KF cows. Body surface temperatures were significantly ($P < 0.05$) higher in KF cows across all measured regions, with eye temperature exhibiting a strong correlation with TNF-α ($r = 0.88$, $P < 0.01$) and cortisol ($r = 0.78$, $P < 0.01$). These findings highlighted the heightened susceptibility of crossbred cows to HS and also provided important new insights into some stress indicators in native and crossbred cows, which could be integrated into farming systems under hot conditions.

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Nutritional garden: Potential way to Improve Nutritional Well- being of Rural Family

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Nutritional gardens are an effective tool to improve dietary diversity and ensure food and nutritional security at the household and community level. By cultivating a variety of vegetables, fruits, and herbs in homestead or community spaces, families gain access to fresh and affordable sources of essential vitamins, minerals, and micronutrients. This practice not only reduces dependence on market purchases but also encourages healthy eating habits and minimizes the risk of malnutrition and hidden hunger. With this objective, continuous Front line demonstrations (FLD) were conducted for three years in the village Raghunandan Bigha, Block Halsi, District Lakhisarai. Rural families (25-30) were provided with the vegetables and green leafy vegetable kits for all three season i.e. Rabi, Kharif and Summer seasons and this approach developed a habit among the family to adopt this technology. Nutritional garden is an improved kitchen garden practice with proper plan. Which resulted in adoption of Nutritional garden technology by the rural families to a greater extent. Nutritional gardens promoted self-sufficiency, empower women, and served as a source of supplementary income also. As a low-cost and sustainable strategy, it plays a significant role in enhancing health, resilience, and overall well-being, making them a vital approach in addressing nutritional challenges, especially in rural areas.

Key words: Nutritional Garden, Food and Nutritional Security, Front Line Demonstration

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Analysis of growth rates in Agricultural Credit Portfolio of the Jaipur Central Co- operative Bank

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The present investigation was undertaken with a view to study the growth rates in the agricultural credit portfolio of the Jaipur Central Co-operative bank. Credit plays an important role in the development of the agriculture sector in India. Expansion of area under irrigation and cultivation of high value crops and horticultural crops require more capital. The farmers have a very low capital base and are mainly dependent on credit. Jaipur Central Co-operative Bank was selected purposely as it is having highest credit flow for the agriculture sector. Secondary data were obtained from the published reports and other official documents of Jaipur Central Co- Operative Bank. The growth rates were computed by fitting the Liner function, semi-log function and exponential function. The best fitted function was used. The results revealed that agricultural and non-agriculture credit recorded a significant positive growth rate of 9.33 per cent and 1.49 per cent per annum, respectively. Both agricultural and non-agricultural credit combined together recorded a significant positive growth rate of 8.93 per cent per annum during the study period. Short-term rabi and kharif seasons recorded a significant positive growth rate of 2.12 per cent and 9.8 per cent per annum, respectively. The significant positive growth in short-term non-agricultural of 1.51 per cent per annum was found. Short term agricultural and non-agricultural credit jointly recorded a significant positive growth rate of 2.00 per cent per annum. In the case of medium-term agricultural credit, a non-significance growth rate of 3.05 per cent per annum was found. The significant positive growth rate of medium- term non-agriculture credit at 3.05 per cent per annum was found. The significant positive growth rate was found for medium- term credit i.e.1.82 per cent per annum during the study period.

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Convolutional Neural Network-Based Risk Assessment Model for Leaf Disease Management in Precision Farming Systems

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Plant leaf diseases pose a critical threat to global agriculture, causing extensive yield losses, food insecurity, and economic challenges, particularly in resource-constrained regions. Traditional detection methods, such as manual inspection and rule-based image processing, are time-intensive, subjective, and limited in accuracy due to human bias and environmental variability. This gap underscores the urgent need for an intelligent, reliable, and integrable framework that can operate efficiently under real-world farming conditions. To address this challenge, we propose a Convolutional Neural Network (CNN)-based risk assessment model for precision farming systems. Unlike conventional classifiers, CNNs perform hierarchical feature extraction, enabling them to capture minute patterns and early symptoms on infected leaves across diverse lighting and climatic conditions. The novelty of this research lies in combining CNN-based visual analysis with agricultural risk profiling to not only classify disease types but also estimate severity levels and associate them with potential crop health risks. Furthermore, the modular architecture allows integration with IoT- enabled environmental sensors and deployment on platforms such as UAV-based crop monitoring, mobile applications, and cloud dashboards. This integrated framework facilitates real-time disease mapping, yield prediction adjustments, targeted agrochemical application, and epidemic early-warning systems. By bridging AI and agronomy, the proposed model supports climate-smart, risk-resilient farming, enhances productivity, and minimizes economic losses, marking a significant step toward sustainable, data-driven agriculture.

Keywords: Convolutional Neural Network (CNN), Leaf Disease Detection, Precision Agriculture, Risk Assessment Model, Smart Farming Systems

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Organic Farming for Sustainable Agriculture

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Agriculture, as the foundation of human civilization, is central to food security, economic stability, and rural livelihoods across the globe. However, the advent of modern farming practices—characterized by intensive use of synthetic fertilizers, pesticides, and high-yielding varieties—has generated serious ecological challenges, including soil degradation, biodiversity loss, water pollution, and greenhouse gas emissions. To address these issues, organic farming has emerged as an alternative for sustainable agriculture which represents a holistic, sustainable agricultural approach that avoids synthetic chemicals, pesticides, and GMOs, while emphasizing soil health, biodiversity, and ecological balance to address environmental challenges, food security, and human health. Organic farming emphasizes natural resource management, use of organic manures, crop rotation, green manuring, composting, vermicomposting biofertilizers, and biological pest control, while minimizing reliance on synthetic fertilizers and pesticides. Consumer demand for organic food is rising due to heightened awareness of environmental and health concerns, making it one of the fastest-growing agricultural sectors. Despite its advantages, organic farming faces limitations such as lower yields, high labour costs, shorter shelf life of products, certification challenges, and restricted market access. Effective policy support, research, and increased public awareness are essential to address these constraints.

Keywords: Organic farming, sustainable agriculture, soil health, modern farming, biodiversity.

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Effect of sowing dates and nutrient management on productivity, profitability and quality of finger millet [*Eleusine coracana (L.) Gaertn.*]

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A field experiment was conducted to study the "Effect of sowing dates and nutrient management on productivity, profitability and quality of finger millet [*Eleusine coracana (L.) Gaertn.*]" at ICAR Research Complex for NEH Region, Umiam, Meghalaya, India, during the kharif season of 2023 and 2024. The experiment was laid out in 2-Factor Randomized Block Design (FRBD) with three replications. The experiment had three sowing dates: D 1 - 1 st June, D 2 - 15 th June, D 3 - 1 st July; and four nutrient management: N 1 - Control (No fertilizer), N 2 - RDF – 40-30-20 kg ha -1 N, P 2 O 5 and K 2 O, N 3 - 100% Organic through FYM, N 4 - 50% Inorganic + 50% Organic through FYM. The pooled result of the two years revealed that sowing dates and nutrient management has a significant effect on productivity, quality and profitability of finger millet. Results from the experiment revealed that the pooled result of sowing date on 1 st July recorded the highest growth parameter, yield and yield attributes, quality parameters and economics, viz., plant population (28.66 m -2), germination (85.59%), number of effective tillers (68.33 m -2), fresh weight (126.62 g plant -1), CGR (4.10 g m -2 day),number of panicles (202.41 m -2), number of fingers ear -1 (7.04), grain finger -1 (332.87), length of finger (7.35 cm), grain yield (1567. 58 kg ha -1), straw yield (4220.91 kg ha -1), harvest index (27.11%), crude protein (6.75%), crude fiber (4.07%), calcium content (1.44%), gross return (₹ 94,055.25), net returns (₹ 66,170.25) and B:C ratio (2.32) when compared to the other two sowing dates. Similarly, among nutrient management, the pooled result of N 4 - 50% Inorganic + 50% Organic through FYM recorded the highest growth, yield, quality parameters and economics, viz., plant height (143.51cm), plant population (29.38 m -2), germination (88.16%), number of effective tillers (73.50 m -2), fresh weight (129.98 g plant -1), LAI (1.62), CGR (3.95 gm -2 day), RGR (0.068 g g -1 day), number of panicles (231.66 m -2), number of fingers ear -1 (7.85), grain finger -1 (346.72), length of finger (8.13 cm), grain yield (1950. 43 kg ha -1), straw yield (5305.66 kg ha -1) and harvest index (26.92%), crude fiber (4.08%), calcium content (1.44%), gross return (₹ 1,17,027.43), net return (₹ 86,477.43) and B:C ratio (2.82). The findings also revealed the pooled results among the interactions, the pooled result revealed that T 12 - D 3 N 4 (Sowing on 1 st July, 50% Inorganic + 50% Organic through FYM) recorded the highest growth, yield and yield attributes, quality parameters and economics. Among the interactions, T 12 - D 3 N 4 recorded the highest yield with 2122.56 kg ha -1 and least was recorded in T 1 - D 1 N 1 (Sowing on 1 st June, Control) with only 705.23 kg ha -1. As grain yield is the ultimate objective of any cultivation practices, hence, only this parameter was considered to identify the best combinations.

Key words: Finger millet, sowing dates, nutrient management, organic, inorganic, economics, interaction.

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Policy Interventions in Agricultural Marketing: Lessons from e-NAM and FPO-led Market Reforms

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Agricultural marketing in India has undergone a major transformation with the introduction of policy innovations such as the Electronic National Agriculture Market (e-NAM) and Farmer Producer Organizations (FPOs). As of 2023, e-NAM connects 1,260 mandis across 22 states, providing farmers with better price discovery and transparency. Similarly, the Government of India's 10,000 FPO formation scheme aims to strengthen farmer collectives for input procurement and collective marketing. Evidence suggests that FPO-linked farmers secure 15–20% higher prices for their produce due to reduced transaction costs and improved bargaining power. However, challenges remain in digital literacy, infrastructure, and equitable participation of women and marginal farmers. Policy reforms should focus on capacity building, credit access, and digital inclusion to maximize the benefits of these innovations. Together, e-NAM and FPOs represent scalable solutions for enhancing efficiency, market integration, and rural income security. Strengthening these models will contribute directly to SDG 9 (Industry, Innovation & Infrastructure) and SDG 12 (Responsible Consumption & Production).

Keywords: Agricultural marketing, e-NAM, Farmer Producer Organizations, Market reforms, Digital inclusion

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Potential of Oyster Mushroom production in supporting Nutrition Security of Farming community of Sheikhpura district.

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Oyster Mushrooms are a type of edible fungus that belongs to the pleurotaceae family. They are characterized by fan shaped or Oyster shaped caps, typically 2-12 inches in diameter with a smooth velvety texture. Gills are attached to the stem, they are narrow and crowded. It has a short & off centre stem and mild sweet flavour and a soft, tender texture. Oyster Mushrooms can be cultivated on straw, wood and other organic materials. They are relatively easy to grow and require minimal care. Oyster Mushrooms have many nutritional benefits such as high protein content, rich in fibre, vitamins and minerals, low in calories and fat. It has many health benefits such as immune system support. Antioxidant properties and anti inflammatory effects. It can increase food availability, improve nutrition and economic status of farming families. The farmers of Sheikhpura are growing Paddy and Wheat in about 40,550 Hectare area which produce about 1562160 Quintal straw which can be used for Mushroom production about 500 Farmers are trained each year by KVK and other agencies of Sheikhpura adding the production of Oyster Mushroom in daily diet of people leading to healthy eating habits and minimizes the risk of malnutrition. The climate of Sheikhpura supports the production of Oyster Mushrooms. So there is a huge potential of Oyster Mushroom production in supporting the Nutrition Security of the farming community of Sheikhpura district of Bihar.

Key words: Oyster Mushroom, Nutrition Security, Farmer training

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Pumpkin: Its Significance in Sustainable Modern Horticulture

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Pumpkin (*Cucurbita moschata.*) is a versatile crop with significant relevance to modern horticulture, valued for its nutritional, economic, and sustainability contributions. Its cultivation, innovative uses, and adaptive traits are central to contemporary horticultural progress. Pumpkins are rich in essential nutrients including β-carotene, lutein, vitamin C, dietary fiber, minerals, and phytonutrients. The fruit, seeds, and peel contain bioactive compounds with proven health benefits such as antioxidant, anti-inflammatory, antimicrobial, and anti-diabetic activities. These attributes qualify pumpkins as both functional foods and promising agents for therapeutic and pharmaceutical applications. Pumpkin cultivation demonstrates adaptability across diverse agro-climatic regions, supporting food security and rural income. Its genetic diversity and resilience enable farmers to select varieties suited to local conditions, improving yield and resource-use efficiency. Modern horticultural practices – including organic farming, integrated pest management, hybrid breeding, and precision technologies – have enhanced pumpkin productivity and environmental sustainability. Pumpkin plants improve soil health through extensive rooting and weed suppression, contributing to sustainable cropping systems. Their low input requirements, ability to serve multiple purposes (food, feed, ornamental, industrial), and climate adaptability make them a smart choice for sustainable agriculture. Pumpkins also support pollinator populations and reduce agrochemical reliance due to their natural pest-resistant properties. As a nutrient-rich and highly adaptable crop, pumpkin stands out in modern horticulture for its role in food production, soil health, climate resilience, and multifunctional market uses. Ongoing innovations in cultivation and utilization further position pumpkin as an important pillar of sustainable and profitable horticultural systems worldwide.

Key Words: Cultivation, Diversity, Modern Horticulture, Pumpkin, and Sustainable

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Soil health:- key to sustainable farming

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Soil health is the backbone of sustainable agriculture and food security. Healthy soil provides essential nutrients, supports plant growth, stores water, and maintains ecological balance. In recent years, modern farming practices such as excessive chemical fertilizer use, over-tillage, and monocropping have caused serious degradation of soil quality. Therefore, maintaining soil health is critical for long-term agricultural productivity and environmental sustainability. The aim of this study is to evaluate the impact of organic and conventional farming practices on soil health and to identify sustainable approaches for improving soil quality. The results revealed that organic farming practices improved soil fertility, enhanced nutrient availability, and increased microbial activity. On the other hand, conventional practices dependent on chemical fertilizers showed reduced biological diversity and gradual decline in soil fertility. The study concludes that adopting sustainable practices such as organic fertilizers, crop rotation, and reduced tillage is essential to maintain soil health. Healthy soils not only ensure long-term productivity but also play a vital role in achieving environmental balance and global food security.

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Role of Foliar-Applied Nano Nitrogen Fertilizer in Enhancing Growth and Yield of Sorghum (*Sorghum bicolor L.*)

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A field experiment was conducted at Agronomy farm of Suresh Gyan Vihar University, Jaipur (Rajasthan) during kharif, 2024 on sandy loam soil, which consisted nine treatments(T1-Control, T2-75% RDN with commercial urea in 2 equal splits - at sowing & 30 DAS, T3- foliar spray of 75% RDN with nano urea in 2 equal splits - 20 & 40 DAS, T4-foliar spray of 75% RDN with nano urea in 3 equal splits - 15, 30 & 45 DAS, T5-100% RDN with commercial urea in 2 equal splits - at sowing & 30 DAS, T6-foliar spray of 100% RDN with nano urea in 2 equal splits - 20 & 40 DAS, T7-foliar spray of 100% RDN with nano urea in 3 equal splits - 15, 30 & 45 DAS, T8-foliar spray of 125% RDN with nano urea in 2 equal splits - 20 & 40 DAS, T9-foliar spray of 125% RDN with nano urea in 3 equal splits - 15, 30 & 45 DAS) in randomized block design with three replications. The recommended dose of fertilizer for sorghum was 80:40:40 NPK kg/ha. The experimental results showed that application of 100% RDN with commercial urea in 2 equal splits at sowing & 30 DAS recorded significantly higher plant height, dry matter accumulation, leaf area index, chlorophyll content, number of leaves, number of tillers per plant, test weight, seed yield, straw yield, biological yield, harvest index, protein content in seed and net returns as well as nutrient content and uptake by sorghum. The maximum grain yield (2768 kg/ha) was registered by application of 100% RDN with commercial urea in 2 equal splits at sowing & 30 DAS which was statistically at par with foliar spray of 125% RDN with nano urea in 3 equal splits at 15, 30 & 45 DAS and foliar spray of 125% RDN with nano urea in two equal splits at 20 & 40 DAS over control and remaining treatments. Same trends were also observed in net returns ₹ 49608/ha) and B: C ratio (2.51).

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SURVEY OF DRY ROOT OF CHICKPEA AND MORPHOLOGICAL VARIABILITY PHYSIOLOGICAL REQUIREMENT BY *Macrophomina phaseolina*

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The chickpea (*Cicer arietinum*) is a legume crop in temperate and sub-tropical regions having the niche for cultivation in several developed and developing countries. It belongs to family Fabaceae, subfamily Faboideae. It is diploid (2n=16) self-pollinating having 740 Mbp genome size. Dry root rot of chickpea caused by *Macrophomina phaseolina* (Tassi) Goid was more prevalent in survey during Rabi season 2020-21 and 2021-22 at Kaithoon (16.55%) followed by Ramganj mandi (14.72%), which was above the district level average (12.23%) of Kota Rajasthan. Seven isolates of *M. phaseolina* studied for their discernible cultural and morphological characters. These isolates showed considerable variation in colony colour, colony diameter, colour, shape and size of sclerotia. Among tested culture mediums, Potato dextrose agar and Czapek's dox agar medium were best for radial growth *M. phaseolina*. Out of six different temperatures 30°C was superior for radial growth *M. phaseolina*, followed by 25°C temperatures. pH requirements of the *M. phaseolina* showed that ideal pH range for obtained good vegetative mass was between pH 6.0 to 6.5.

Key Word: Chickpea, *Macrophomina phaseolina*, Dry root rot, Culture medium, pH

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Innovative Natural Resource Management in Soil Science: Pathways for Sustainable

Agriculture and Climate Resilience

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The management of natural resources, particularly soil, is central to the sustainability and resilience of future agriculture. With increasing pressures from climate change, land degradation, and declining soil fertility, innovations in soil science offer critical solutions for optimizing productivity while conserving ecological balance. This study explores emerging approaches in natural resource management that integrate soil health restoration, water-use efficiency, and carbon sequestration to support climate-smart Agriculture. Drawing on case studies and experimental data, the paper highlights advancements in biochar application, precision nutrient management, conservation tillage, and soil microbial enhancement. These innovations not only improve soil organic matter and nutrient cycling but also strengthen ecosystem services essential for food security. Special attention is given to the role of digital tools and geospatial technologies in monitoring soil resources, enabling farmers and policymakers to make data-driven decisions for sustainable land use. Key themes emphasize the interconnectedness of soil health, water conservation, and biodiversity in ensuring resilient farming systems. Furthermore, the socio-economic and policy dimensions influencing the adoption of soil-focused innovations are examined, stressing the need for inclusive frameworks that promote farmer participation, equitable access to resources, and long-term environmental stewardship. Our findings underscore the urgent call for multidisciplinary collaboration to harness innovations in soil science for sustainable natural resource management. By aligning scientific research with local practices and policy support, agriculture can transition toward systems that are productive, climate-resilient, and environmentally sound.

Keywords: Soil health, natural resource management, innovation, sustainable agriculture, climate resilience

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Diagnostic Utility of Milk Constituents, Enzymes, and Electrolytes for Subclinical Mastitis Detection in Dairy Cattle

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Subclinical mastitis (SCM) is one of the most prevalent and economically significant diseases in dairy cattle, primarily due to its asymptomatic nature and the resulting decline in milk yield and quality. The present study was undertaken to evaluate alterations in milk composition, physicochemical attributes, and associated biochemical markers in healthy and SCM-affected cows reared under tropical conditions. In cattle, SCM milk samples showed a significant decline in lactose levels, while fat and protein percentages varied inconsistently between healthy and affected groups. Notably, electrical conductivity (EC) and pH values were consistently elevated in SCM milk, reflecting disruption of the mammary epithelium and ionic imbalance. Enzymatic activities including lactate dehydrogenase (LDH), N-acetyl- β-D-glucosaminidase (NAGase), and alkaline phosphatase (ALP) were markedly higher in high somatic cell count (SCC) groups, indicating mammary tissue damage and inflammatory response. Parallel changes in electrolytes were also evident, with sodium and chloride concentrations significantly increasing, while potassium levels declined in association with higher SCC. Receiver operating characteristic (ROC) curve analysis further demonstrated that lactose, EC, and pH were the most reliable diagnostic indicators of SCM, with area under the curve (AUC) values of 0.871, 0.904, and 0.900, respectively, thereby confirming their diagnostic robustness. These findings establish that simple, non-invasive measures such as EC, pH, and lactose can serve as sensitive biomarkers for the early detection of SCM in dairy cattle, and may offer a practical alternative or complement to conventional SCC-based screening in tropical dairy production systems.

Keywords: Subclinical mastitis, dairy cattle, somatic cell count, milk composition, electrical conductivity, pH, lactose, enzymes

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Scope of Natural farming in India

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Natural Farming (NF) is understood as a chemical free farming practice involving livestock integrated natural farming methods and diversified crop systems rooted in the Indian traditional knowledge and also it is location specific & follows the agro-ecological principles and is rooted in the local knowledge. Practices such as use of natural inputs, mulching, green cover etc increases the soil organic biomass & water infiltration, improves soil structure and contributes to the nutrient cycle and soil composition Natural Farming recognizes the natural interdependence of soil, microbiome, plants, animals, climate and human agricultural requirements. Since last decade, concerted efforts are being undertaken in India to create the right perspective among different stakeholders to adopt science based natural farming practices. India can safely shift 2% of cultivated area each year from conventional farming to organic or natural farming (ONF) without any effect on food supply and has scope to replace around 20 per cent of area from conventional farming to ONF by 2030. The National Institution for Transforming India (NITI) Aayog has also emphasized on 'natural farming'. However, community organizations and farmers use 'organic' and 'natural' farming terms interchangeably. It is roughly estimated that around 2.5 million farmers in India are practicing regenerative agriculture. In the next 5 years, it is expected to reach 20 lakh hectares in any form of organic farming, including natural farming, of which 12 lakh hectares are under Bharatiya Prakritik Krishi Padhati. States such as Andhra Pradesh, Himachal Pradesh, Gujarat, Haryana, Karnataka and Kerala are promoting natural farming. Andhra Pradesh is the front runner among all states in implementing natural farming programmes at a mass scale. In Andhra Pradesh government, as of March 2020, 0.62 million farmers (10.5 per cent of all farmers) were enrolled in the programme. Of the enrolled farmers, 0.44 million farmers (7.5 per cent), were actually practising natural farming on an area of 0.45 million acres, which works out to 2.9 per cent of the net sown area spread across 3,011 numbers of gram panchayats. Karnataka recently initiated implementation of ZBNF on a pilot basis in 2,000 hectares in each of the 10 agro-climatic zones of the state.

Key words: Natural farming, Niti ayog, Organic or natural farming, Bharatiya Prakritik Krishi Padhati

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Effect of inoculation and N level on yield and protein content of winged bean tuber

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Winged bean is a high protein crop for the tropics. It is considered as ‘a supermarket on a stalk’ because practically almost all the parts of the plant are edible. Leaves can be eaten like spinach (rich in vitamin A), younger pods as vegetables, tubers can be eaten raw or cooked like potato (exceptionally rich in protein 2-4 times more than potato) and seeds can be used in similar ways as soybean. The features that describe its potential for an expanded role in agriculture are its nutritional quality, profuse nodulation, high nitrogen fixing capacity, strong tropical adaptation and high yielding capacity. A field experiment consisting of four seed-inoculation treatments [No inoculation, Rhizobium, PGPR (Bacillus) and Rhizobium + PGPR (Bacillus)] and three nitrogen levels [0, 20 and 40 kg ha -1] in RBD (factorial) with three replications for evaluation of two winged bean germplasm, IC-17002 and DLN-9 during crop season in the year 2014-15 and with better-performing germplasm, IC- 17002 in 2015-16 to find out impact of the Rhizobium as seed inoculant alone or in combinedly with PGPR on yield and protein content in tuber of winged bean were conducted at Tirhut College of Agriculture, Dholi Farm of RPCAU, Pusa (Bihar). The effect of different treatments on yield and protein content in tubers ranged from 29.00 to 93.34 q ha -1 and 12.57 to 19.07%. The individual effect of either seed inoculation or N application significantly increased yield and protein content except N application in seed (found non-significant). Among inoculation treatments irrespective of N levels, inoculation with either Rhizobium alone or in combination with PGPR significantly increased protein content over control whereas inoculation of PGPR alone did not affect significantly in both the parameters. Among N levels irrespective of inoculation, highest protein content of 17.72% was noted with lower dose of nitrogen application i.e., @ 20 kg ha -1 in tuber. The treatment of 20 kg N ha -1 application was found statistically at par with N application of 40 kg ha -1 . Similarly, the highest yield of 93.34 q ha -1 followed by 73.34 q ha -1 was recorded in the same treatments as of protein content and stood statistically at par to each other. Interaction effect of inoculation and N levels i.e., IxN, was found non-significant in both the cases. Highest yield (q ha -1) and protein content (%) was recorded where seeds were inoculated with Rhizobium + PGPR along with 20 kg N ha -1 in all the three plant parts.

Key words: Winged bean, PGPR, Rhizobium, protein content, N level, tuber.

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Effect of Integrated Nutrient Management on Growth, Yield and Quality of Cucumber (*Cucumis sativus L.*)

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Cucumber (*Cucumis sativus L.*) belongs to the family Cucurbitaceae and has a chromosome number of 2n = 2x = 14. It is a warm-season, annual, monoecious vine, cultivated for its tender fruits consumed as vegetables. Integrated Nutrient Management (INM) is an ecologically sound and economically viable approach that combines chemical fertilizers, organic manures, and biofertilizers to maintain soil fertility and achieve optimum crop yield. A field experiment entitled " Effect of Integrated Nutrient Management (INM) on Growth, Yield and Quality of Cucumber (*Cucumis sativus L.*)" was conducted during the Kharif season of 2024-25 at the Horticultural Research Farm, School of Agriculture, Suresh Gyan Vihar University, Jaipur. The study was aimed at evaluating the effect of different integrated nutrient management practices on cucumber under the semi-arid conditions of Jaipur. The experiment was laid out in Randomized Block Design (RBD) with ten treatments: T_1 – Control, T_2 – 100% RDF (100:60:60 NPK/ha), T_3 – 100% FYM (25 t/ha), T_4 – 100% Vermicompost (10 t/ha), T_5 – 75% RDF + 25% FYM, T_6 – 75% RDF + 25% Vermicompost, T_7 – 50% RDF + 50% FYM, T_8 – 50% RDF + 50% Vermicompost, T_9 – 75% RDF + 12.5% FYM + 12.5% Vermicompost, and T_{10} – 50% RDF + 25% FYM + 25% Vermicompost, laid out in a Randomized Block Design (RBD) with three replications. The variety used was 'Pusa Uday'. The results revealed that the treatment T_9 (75% RDF + 12.5% FYM + 12.5% Vermicompost) recorded the best performance among all treatments. This treatment significantly enhanced plant growth, fruit yield, and quality parameters compared to both control and sole fertilizer applications. The highest total fruit yield (253.38 q/ha), maximum TSS (3.84° Brix), and longest shelf life (7.86 days) were recorded in T_9. It also resulted in the highest net return (₹1,52,076/ha) and benefit-cost ratio (4.00), thus proving its economic superiority.

Key words: INM, Organic manures, Biofertilizer, RBD, TSS, FYM, Vermicompost

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Soil Health Card Schemes: Fostering Sustainable Agriculture Growth

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Soil is the backbone of agriculture and the key to ensuring food security and sustainable livelihoods. However, in India, soil resources face multiple challenges such as nutrient depletion, overuse of chemical fertilizers, declining fertility, and soil degradation. These issues have resulted in reduced productivity, lower farm income, and threats to environmental balance. Recognizing this critical need, the Government of India launched the Soil Health Card (SHC) Scheme in 2015 as a nationwide initiative. The SHC serves as a scientific tool for farmers, much like a doctor's prescription for soil. It provides comprehensive information on the nutrient status of the soil, fertilizer recommendations, and crop suitability. By adopting these recommendations, farmers can achieve balanced use of fertilizers, reduce wastage, and improve input efficiency. This, in turn, leads to higher yields, reduced costs, and greater farm profitability. Since its launch, the scheme has made remarkable progress, with over 23 crore SHCs distributed across the country. Many success stories indicate how farmers have benefited from reduced fertilizer usage and enhanced crop productivity. At the same time, extension services have been instrumental in raising awareness. Campaigns, farmer fairs, ICT-based advisories, and the involvement of SHGs, FPOs, and cooperatives have ensured wider reach. Yet, the scheme faces challenges such as low awareness among small and marginal farmers, limited soil testing labs, staff shortages, and the lack of continuous monitoring. To overcome these gaps, future strategies must focus on strengthening infrastructure, expanding mobile soil testing units, and training extension workers to provide personalized support. Integrating SHC data with precision farming technologies and promoting collective soil management through farmer organizations will further enhance sustainability.The Soil Health Card Scheme is a transformative step toward sustainable agriculture. With stronger implementation and farmer participation, it can ensure healthy soils, higher productivity, and a resilient farming system for future generations.

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"Climate-Smart Agriculture (CSA) in dryland :Soil health and livestock management, innovative technologies and breeding approaches For dryland agriculture"

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Climate-Smart Agriculture (CSA)

CSA is an approach that aims to promote agricultural practices and systems that support the resilience of farmers and agricultural systems to climate change. In dryland areas, CSA can help farmers adapt to climate-related stresses, such as droughts and heat waves.

Water Management

1. Rainwater harvesting: Collecting and storing rainwater for irrigation and other uses.
2. Drip irrigation: Delivering water directly to the roots of plants, reducing evaporation and runoff.
3. Mulching: Retaining soil moisture and reducing soil temperature.

Soil Health Management

1. Conservation agriculture: Minimizing soil disturbance, retaining crop residues, and using cover crops.
2. Organic amendments: Adding organic matter, such as compost or manure, to improve soil fertility and structure.
3. Crop rotation: Rotating crops to improve soil fertility, structure, and biodiversity.

Livestock Management

1. Drought-tolerant breeds: Selecting breeds that are adapted to dryland conditions.
2. Feed conservation: Conserving feed for livestock during periods of drought or scarcity.
3. Mob grazing: Managing grazing to promote soil health and biodiversity.

Breeding Approaches

1. Drought-tolerant crops: Breeding crops that are resistant to drought and heat stress.
2. Climate-resilient livestock: Breeding livestock that are adapted to climate-related stresses.

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Genome editing based synthetic apomixis: A move towards hybrid vigour

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Apomixis is an asexual reproduction process in which clonal seeds are formed without meiosis and fertilization. Because of its potential in permanently preserving hybrid vigor, apomixis has attracted a great deal of interest from plant biologists and the seed industry. However, despite decades of effort, introgression of apomixis traits from wild relatives into major crops has remained unsuccessful. Genome modifications utilizing genome editing technologies (GETs), such as clustered regularly interspaced short palindromic repeats (CRISPR)/CRISPR- associated protein (cas), a reverse genetics tool, have paved the way toward the utilization of emerging technologies in plant molecular biology (Fiyaz et al., 2021). The vast availability of GETs has made functional genomics studies easy to conduct in crops important for food security. The development of MiMe (mitosis instead of meiosis) genotypes has been utilized for clonal gamete production. Furthermore, induction of haploid plants from egg cells can be achieved by either egg cell specific expression of BABY BOOM1 (BBM1), or disruption of MATRILINEAL (MTL) using CRISPR/Cas9 gene-editing technology. Mieulet et al. (2016) identified the Ososd1 (Oryza sativa OSD mutation) mutant in rice from Oryza Tag Line insertion line insertion library and generated OsMiMe genotype with combination of pair1, rec8 and osd1 mutations which turns meiosis into mitosis leading to the production of male and female clonal diploid gametes. The double-haploid progenies (diploids) from haploid S-Apo plants could be clonally propagated for multiple generations, suggesting that asexual propagation through seeds is feasible in rice by combining MiMe-mediated apomeiosis with ectopic expression of BBM1. The efficiency of clonal propagation including, frequency of parthenogenesis, which could potentially be improved in the future with different promoters by expanding data collection for genomic dissection of apomixis loci and clear regulatory network of each component of apomixis, cell-to-cell signaling will provide strong foundation for engineering of apomixis in crops to produce a fertile highly expressive apomict, with no off- target effects of gene editing.

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Effect of Spatial Variability of Microclimate on Crop Growth characteristics in a Naturally Ventilated Poly house

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The significance of protected cultivation is progressively increasing due to its potential to overcome challenges of climate change by facilitating year-round crop production and to enhance overall crop yield for food security of the growing population. Among the various forms of protected cultivation, polyhouse cultivation offers an effective approach to capitalize on these benefits. Achieving optimum crop productivity within a polyhouse environment necessitates a comprehensive understanding of the spatial and temporal variability of the microclimate and its corresponding influence on plant growth. The present investigation was conducted to assess the spatial distribution of microclimatic parameters inside a naturally ventilated polyhouse and evaluate their effect on crop performance during the summer season. For this purpose, microclimatic data were recorded daily from Mid-March to Mid-June, 2024 at four specific time intervals of 8:30 AM, 12:30 PM, 4:30 PM and 8:30 PM. The collected data was processed and analyzed using Golden Surfer software to generate contour plots presenting the mean monthly distribution of microclimatic variables. To examine the impact of microclimate on plant growth, Basil (*Ocimum basilicum L.*) was cultivated under hydroponic conditions and growth parameters were recorded at every 10-day interval. This heterogeneity in the microclimate led to non-uniform crop growth across the hydroponics structures. Variations in crop performance were observed between different frames. The central region of the polyhouse offered more favorable conditions for enhanced growth in summer months with foggers. It was concluded that the spatial distribution of microclimatic parameters significantly influenced crop development and achieving uniform growth may require the implementation of effective ventilation management strategies.

Key words: Hydroponics, Naturally Ventilated Polyhouse, Microclimate, Spatial Variability, Basil Crop.

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STUDY OF GENETIC DIVERSITY IN OKRA

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The present experiment was conducted on study of Genetic diversity in Okra (*Abelmoschus esculentus L.*). The experiment was carried out during Rabi season and the genotypes were sown in October month, in the year 2021-22. The study was undertaken on 37 genotypes of okra using randomized block design (RBD) with three replications. It can be concluded that all the 37 genotypes of okra are grouped into nine clusters. The cluster VI showed maximum intra-cluster distance and maximum inter-cluster distance was observed between clusters IX and VIII. Days to first picking (37.99%) followed by chlorophyll content (27.93%) and number of fruits per plant (9.76 %) were the highest yield contributing characters towards total diversity. Among the 37 genotypes, IC33823, IC42490, EC329422, IC42484 and IC42470 are more genetically diverse and can be used in hybridization programmes, for obtaining superior and desirable recombinants. Hence, it will be more rewarding to bring improvement in okra.

Keywords: Okra, Genetic divergence, Clusters, Genotypes.

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Soil Health for Sustainable Agriculture and Climate Resilience

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Structure, increase organic matter, and support diverse microbial populations, which in turn improve soil fertility and carbon sequestration. By enhancing soil health, these practices also increase the resilience Soil health is critical for achieving sustainable agriculture and enhancing climate resilience. Healthy soils provide essential services such as nutrient cycling, water infiltration, and habitat for beneficial microorganisms, which together support robust crop growth and biodiversity. Maintaining soil health is vital for ensuring long-term agricultural productivity while minimizing environmental impact. In agricultural systems, soil health is shaped by a combination of physical, chemical, and biological factors. These include soil texture, organic matter content, microbial communities, pH levels, and nutrient availability. A healthy soil ecosystem improves soil structure, increases water retention, and enhances nutrient cycling, all of which are essential for crops to thrive, especially in the face of changing climate conditions. Unsustainable farming practices—such as excessive use of chemical fertilizers, monoculture cropping, and improper irrigation—can degrade soil health over time. This leads to issues like soil erosion, nutrient depletion, reduced microbial diversity, and diminished soil fertility. These consequences not only hinder agricultural productivity but also compromise the soil's ability to act as a carbon sink, exacerbating climate change. To promote soil health, sustainable practices such as crop rotation, cover cropping, no-till farming, and the use of organic amendments (e.g., compost and biochar) are essential. These techniques restore soil of agricultural systems to climate stressors such as droughts and floods. Healthy soils are the foundation for sustainable agriculture and climate resilience. Through responsible soil management, we can enhance food security, restore degraded lands, and mitigate the impacts of climate change.

Keywords: Soil health, sustainable agriculture, climate resilience, soil degradation, organic matter, crop rotation, carbon sequestration, soil fertility, microbial diversity, climate change.

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Evaluation of bioactive secondary metabolites from antagonistic bacteria against onion basal rot caused by *Fusarium oxysporum f. sp. cepae*

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Onion (*Allium cepa L.*) is a significant horticultural crop, but its productivity is often constrained by basal rot, leading to considerable economic losses. Excessive reliance on chemical fungicides for managing the disease raises concerns regarding environmental safety and human health, necessitating sustainable control strategies. This study investigates the potential of bacterial secondary metabolites for suppressing the basal rot pathogen. Diseased onion samples were collected from major cultivation areas in Tamil Nadu, and the causal agent was isolated, identified, and confirmed through pathogenicity assays. Beneficial bacteria from rhizosphere soils and onion basal plates were isolated and screened using dual culture techniques. Dual culture screening identified potential antagonists with inhibition percentages 87.27% (LBO6), 43.2% (BR2) with endophytic isolates showing suppression at 81.81% (BPE4). Secondary metabolites were extracted using ethyl acetate, purified, and evaluated via agar well diffusion assays, showing strong antifungal effects. The results demonstrate the potential of bacterial metabolites as eco-friendly alternatives to conventional fungicides.

Keywords: biocontrol, , endophytes, sustainable crop protection, antifungal activity

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Response of nutrient management on growth parameters of fodder legumes intercrop with fodder maize

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The experiment was carried out during 2022 at Agronomy farm of School of Agricultural Sciences, Medziphema, to evaluate the effect of nutrient management on performance of fodder cowpea and fodder rice bean grown as an intercrop with fodder maize. The experiment was laid out in RBD with 24 treatments it consists of eight different row ratios i.e., C 1 -cowpea (sole), C 2 -rice bean (sole), C 3 -M+C (1:1), C 4 -M+R (1:1), C 5 -M+C (2:1), C 6 -M+R (2:1), C 7 -M+R (2:1), C 8 -M+C (2:2), C 9 -M+R (2:2) with three different nutrients level i.e., F 0 -control, F 1 -50% NPK, F 2 -100% NPK and replicated thrice. The result revealed that nutrient application on fodder maize showed a significant influence on intercrop fodder legumes crop. The application of nutrients at different levels caused a significant impact on growth parameters of fodder legumes crop. In all the observation stages, application of 100% NPK significantly recorded higher growth and development followed by 50% NPK. The higher growth parameters were observed in fodder cowpea as compared to fodder rice bean. The treatment C 1 F 2 registered the higher plant height and leaf length at 20, 40, 60 and 80 DAS. Higher leaf width and leaf area at 20, 40 and 60 DAS was obtained at C 1 F 2 , while C 4 F 2 registered the higher leaf width (10.30 cm) and leaf area (147.73 cm) was recorded at 80 DAS. The higher number of leaves plant -1 at 20, 40, 60 and 80 DAS was recorded at C 2 F 2 followed by C 4 F 2 . The stem girth and primary branches plant -1 at 20, 40 and 60 DAS was recorded at C 2 F 2 . The fresh weight and dry weight were found to be increased with increases in nutrient doses. The higher fresh weight (22.53 g, 296.87 g, 471.97g, 559.57 g) and dry weight (3.91 g, 33.28 g, 119.09 g, 150.08 g) at 20, 40, 60 and 80 DAS was recorded at C 2 F 2 followed by C 4 F 2 .

Keywords: Fodder legumes, nutrient management, growth parameters

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Isolation and characterization of uropathogenic Escherichia coli isolates from human and animal urine samples

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Urinary tract infections (UTIs) are among the most common bacterial infections and pose a significant public health concern. Uropathogenic Escherichia coli (UPEC) are the primary causative agents of UTIs. This study aimed to detect the presence of type 1 fimbriae, specifically the fimH gene, in UPEC strains using molecular methods. A total of 38 E. coli isolates were obtained from 98 human urine samples collected from Human Diagnostic Laboratories in Patna, Bihar. Additionally, one isolate was isolated from five canine urine samples collected from the Veterinary Clinical Complex, Bihar Veterinary College, Patna. For isolation, approximately 1 mL of each. A urine sample was inoculated into 10 mL of pre-sterilized MacConkey broth. After overnight incubation, turbid cultures were streaked onto Eosin Methylene Blue agar and incubated at 37°C for 24 hours. Characteristic E. coli colonies having purple with black centres and a green metallic sheen were further confirmed by Gram staining, biochemical tests, and PCR targeting the species-specific 16S rRNA gene. All isolates produced a 544 bp amplicon, confirming their identity as E. coli. Subsequently, all 39 confirmed E. coli isolates (38 human, 1 canine) were screened for the fimH gene, a marker for type 1 fimbriae. PCR analysis revealed that 36 of the 39 isolates (92.3%) carried the fimH gene, producing a specific 164 bp amplicon. These findings indicated that over 92% of the E. coli isolates harbored the fimH gene. This gene encodes the FimH adhesin, which facilitates bacterial attachment to mannose-containing receptors on host cells which is an essential step in the pathogenesis of UTIs. The strong binding affinity of FimH may contribute to the increased virulence of UPEC strains. Understanding the role of FimH is crucial for the development of effective diagnostic and therapeutic strategies against UTIs.

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Plant-Based Milk: A Sustainable Revolution in Dairy Alternatives and Nutritional Innovation

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The growing demand for sustainable and health-conscious food choices has triggered the rise of plant-based milk as a viable alternative to traditional dairy. Derived from sources such as soy, almond, oat, coconut, and pea, plant-based milk offers diverse nutritional profiles, functional benefits, and environmental advantages over conventional dairy. This review explores the production processes, nutritional composition, sensory attributes, and market trends of plant-based milk. Additionally, it highlights the challenges associated with fortification, consumer acceptance, and regulatory considerations. Coconut milk is a white, opaque liquid, is an emulsion of natural oil in water, extracted from shredded coconut endosperm either with or without water. The present study was conducted to optimize the process parameters for the preparation of coconut milk. The process parameters were time (10-30 min), temperature (55-60 0 C) and concentration of sodium caseinate (0.3-0.7%). The effect of these process parameters were observed on the various quality parameters of coconut milk viz. pH, total color difference, total solids, viscosity, DPPH, phenols and overall acceptability. The optimum process parameter for the preparation of coconut milk was observed as optimum extraction time 30 mins, extraction temperature: 60 0 C); and sodium caseinate concentration: 0.476%. The coconut milk prepared at the optimized condition was stored at ambient and refrigerated condition for its shelf life evaluation which was observed as 2 days in ambient condition & 15 days in refrigerated condition.

Keywords: Plant-based milk, dairy alternatives, sustainability, coconut, shelf life.

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CLIMATE CHANGE AND SIMULATION

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With notable long-term changes in temperature, precipitation patterns, and other climate-related factors, climate change is one of the most urgent global issues of the twenty-first century. Climate change is mostly caused by human activities like burning fossil fuels, deforestation, and industrial emissions. These activities raise the concentrations of greenhouse gases in the atmosphere, which in turn causes global warming, sea level rise, polar ice melting, extreme weather, and biodiversity loss. Predicting future climate impacts and developing successful mitigation and adaptation plans require an understanding of the intricate relationships between atmospheric, oceanic, terrestrial, and human systems. In order to improve our comprehension of climate dynamics and forecast future climatic scenarios, climate simulation is essential. Advanced computer models called General Circulation Models (GCMs) or Earth System Models (ESMs) are used to carry out these simulations. These models take into account physical processes including radiation balance, atmospheric chemistry, cloud formation, ocean currents, and land-surface interactions. These models simulate climate behaviour over decades to centuries under various greenhouse gas emission trajectories by solving mathematical equations that represent the laws of physics. Simulations enable scientists to examine potential consequences under different socio- economic trajectories, enabling policymakers to determine the likely effects of alternative approaches, e.g., emissions cuts or carbon capture programmes. Although crucial, climate models are confronted with uncertainties in input data, limited spatial resolution, and challenges in well-representing small-scale processes like cloud processes and aerosol interactions. Nevertheless, ongoing advances in computing capacities and observation data have largely increased the credibility of climate simulations for decades . In sum, climate simulation is an essential scientific application for the investigation of climate change. It allows for thorough examination of prospective climate conditions, informs evidence-based policy, and assists society in adapting to the negative impacts of global warming. Current research continues to develop models, minimize uncertainties, and include socio-economic considerations with the aim of painting a better picture of our planet and future under altered climatic conditions.

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Effect of zinc application on yield and uptake of hybrid rice

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The field study was conducted at the Main Rice Research Centre, Navsari Agricultural University, Navsari, Gujarat during kharif 2019-2021 to compare yield of hybrid rice in response to zinc sulphate and zn-ethylene diamine tetraacetate as zn source which were incorporated into soil as basal application and applied as foliar spray at tillering and panicle initiation stage and carried out in randomized block design with four replications. The results revealed that yield attributes and rice yield was significantly enhanced in addition to zinc sources over control. The maximum panicle length, panicle weight, grain and straw yield were recorded with application of zinc as per soil test based application through Zn EDTA and was on par with spraying of 0.05 and 0.1 % Zn EDTA both at tillering and panicle initiation stage. Zn EDTA resulted in greater values for these parameters as compared to other Zn sources. It also recorded higher Zn content in rice straw and Zn uptake in rice plants. Thus, Zn EDTA proved to be efficient sources as foliar spray @ 0.05 % for rice production and Zn uptake by rice plant.

Keywords: Hybrid rice, zinc sulphate, Zn-EDTA, foliar spray, uptake, yield

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PERCEPTION OF CHICKPEA GROWERS TOWARDS CLIMATE CHANGE IN BEMETARA DISTRICT OF CHHATTISGARH

Surya Dev Verma

In the Bemetara district of Chhattisgarh, twelve villages in the Saja and Bemetara block were the sites of an investigation called "PERCEPTION OF CHICKPEA GROWERS TOWARDS CLIMATE CHANGE IN BEMETARA DISTRICT OF CHHATTISGARH." A planned interview schedule was used to gather data from 120 chickpea growers in a purposeful manner. Results were obtained by evaluating the data using the proper statistical methods. To learn more about how chickpea growers see climate change, 14 independent variables were purposefully chosen. The study's findings showed that, of the fourteen variables, thirteen - education, farming experience, annual income, land holding, area under chickpea crop, credit access, knowledge level of climate change, economic motivation, scientific orientation, extension contact, mass media exposure and information seeking behavior were significantly and favorably correlated with perception of chickpea growers towards climate change. The perception of chickpea growers towards climate change is found to be adversely and non-significantly correlated with age. Using the correlation coefficient between the independent and dependent variables, this conclusion was reached. 70.00 percent of chickpea growers indicated that their perception of chickpea growers towards climate change was medium. In constraint analysis, lack of climate change resilient chickpea varieties, followed by lack of technical know-how on climate change, were two major constraints experienced by 99.17% and 95.83% of chickpea growers, respectively. These findings provide insights for future research on the perception of chickpea growers towards climate change.

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Vertical Farming: A Sustainable Pathway for Future Agriculture

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Global food security is seriously threatened by agriculture at this pivotal moment due to factors like population growth, declining arable land, and changing climatic conditions. In the upcoming decades, the growing demand for wholesome food may exceed the supply of conventional farming techniques alone. A sustainable and futuristic alternative, vertical farming offers creative ways to increase output while using fewer resources. This method guarantees year-round production that is less susceptible to outside climatic stresses by growing crops in vertically stacked layers under controlled conditions. Vertical farming systems commonly integrate hydroponics, aeroponics, and aquaponics, supported by modern technologies such as LED lighting, sensors, artificial intelligence, and Internet of Things (IoT). These innovations enable precise monitoring of water, nutrients, and energy, thereby reducing input costs while enhancing output quality. One of the most striking advantages of vertical farming is its capacity to reduce water usage by nearly 90% compared to traditional agriculture, while eliminating the need for harmful pesticides. Additionally, its proximity to urban areas reduces the carbon footprint associated with food transportation and ensures fresher produce for consumers. This paper highlights the potential of vertical farming to transform Indian agriculture in alignment with the vision of FutureAG 2025. It discusses resource efficiency, crop diversification, employment opportunities in agri-tech sectors, and the potential role of renewable energy in reducing the energy burden of indoor farming systems. However, challenges remain in the form of high initial investment, skilled labour requirements, and the need for supportive policy frameworks. The findings suggest that vertical farming, if integrated with sustainable practices and supported by government incentives, can serve as a cornerstone of climate-resilient agriculture. It holds the promise of bridging the gap between food demand and supply, ensuring nutritional security, and creating a technologically empowered farming system for future generations.

Keywords: Vertical farming, sustainable agriculture, hydroponics, climate resilience, food security, FutureAG 2025

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"Organic Farming: A Pathway to Sustainable and Resilient Agriculture"

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Organic farming is gaining traction as a sustainable approach to agriculture amidst growing concerns about environmental impact, soil health, and chemical use in conventional farming. This paper explores the potential of organic farming to transform Indian agriculture in alignment with the vision of FutureAG 2025. It discusses resource efficiency, crop diversification, employment opportunities in organic agri-business sectors, and the role of organic practices in enhancing soil health and reducing environmental footprint. Challenges remain in the form of yield gaps, certification processes, market access, and the need for supportive policy frameworks. The findings suggest that integrating organic farming with sustainable practices, supported by government incentives, can serve as a cornerstone of climate-resilient agriculture. It holds the promise of bridging the gap between consumer demand for organic produce and supply, ensuring nutritional security, and creating a technologically empowered farming system for future generations.

Keywords: Organic farming, sustainable agriculture, climate resilience, soil health, food security, FutureAG 2025

ISBN: 978-93-344-1457-8 **FA/2025/048**

"Soil to Sustenance: Linking Soil Health and Food Quality"

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Soil health is increasingly recognized as a cornerstone of sustainable agriculture. This qualitative study explores agroecological practices, perceptions, and outcomes related to soil health management across diverse contexts in five countries. Through in-depth interviews with farmers, agronomists, and food producers, we examine how local knowledge, traditional practices, and innovative approaches influence soil functionality, nutritional quality, and sensory attributes of food.

Key findings highlight the role of organic amendments, crop diversity, minimal tillage, and integrated nutrient management in fostering resilient soil ecosystems. Participants reported improvements in crop flavor, shelf-life, and nutrient density when prioritizing soil regeneration. Socio-cultural and economic factors shape the adoption of soil-friendly practices, including access to resources, market incentives, and policy frameworks.

Transdisciplinary collaboration and context-specific solutions to rebuild soil health are urgent needs for nourishing and sustainable food systems. This research contributes to evidence that qualitative insights are essential for designing effective interventions at the nexus of soil and food.

Keywords: Soil health, food quality, agroecology, sustainable farming

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Advancing Climate-Smart Agriculture for a Resilient Future: Insights from FutureAg 2025

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Advancing Climate-Smart Agriculture for a Resilient Future: Insights from FutureAg 2025 The global agricultural landscape faces unprecedented challenges from climate change, necessitating a paradigm shift towards resilient and sustainable food systems. This abstract for FutureAg 2025 explores the critical role of Climate-Smart Agriculture (CSA) in mitigating climate impacts, enhancing adaptation, and ensuring food security for a growing global population. We invite submissions and discussions focusing on innovative CSA practices, policies, and technologies that foster agricultural resilience and sustainability. Key themes include, but are not limited to: the integration of traditional knowledge with modern agricultural science; advancements in precision agriculture, remote sensing, and AI for optimized resource management; development of climate-resilient crop varieties and livestock breeds; sustainable land and water management strategies; economic and social dimensions of CSA adoption, including policy frameworks and farmer empowerment; and the role of international collaboration in scaling up CSA initiatives. FutureAg 2025 aims to be a pivotal platform for researchers, policymakers, practitioners, and industry stakeholders to share cutting-edge research, foster interdisciplinary collaborations, and collectively chart a course towards a climate-resilient and food-secure future.

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Variability and Correlation Analysis for Yield, Yield Attributes and Quality Traits in Tomato (*Solanum lycopersicum L.*)

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The present investigation entitled "Variability and Correlation Analysis for Yield, Yield Attributes and Quality Traits in Tomato (*Solanum lycopersicum L.*)" was carried out during Kharif 2024 at Agriculture Research farm SGVU, Jaipur with the objective of assessing the extent of genetic variability, heritability, genetic advance and correlation among different traits of tomato. A set of 10 genotypes of tomato was evaluated in a randomized block design with three replications. Observations were recorded on growth, yield and quality parameters including days to 50% flowering, plant height, number of branches per plant, number of fruits per plant, fruit length, fruit diameter, fruit weight, fruit yield per plant, total soluble solids, acidity and ascorbic acid content. Analysis of variance revealed significant differences among genotypes for all traits studied, indicating the presence of considerable genetic variability in the experimental material. Estimates of genotypic and phenotypic coefficients of variation indicated that number of fruits per plant and ascorbic acid content exhibited high variability, suggesting ample scope for improvement through selection. Moderate variation was observed for the number of branches per plant, whereas traits such as fruit diameter, fruit length, plant height, days to 50% flowering, fruit yield per plant, fruit weight, TSS, acidity and ascorbic acid content showed comparatively low variability. Heritability estimates were high for fruit yield per plant, fruit diameter, fruit length, number of fruits per plant, plant height, acidity and average fruit weight, suggesting that selection based on phenotypic performance would be reliable. Moderate heritability was recorded for days to 50% flowering, while low heritability was found for the number of branches per plant. Genetic advance as per cent of mean was moderate for number of fruits per plant, fruit diameter, fruit yield per plant, plant height, average fruit weight, acidity, TSS and ascorbic acid content, reflecting the role of both additive and non-additive gene effects. Correlation analysis revealed that fruit yield per plant had a positive and significant association with fruit length, fruit diameter and acidity at both genotypic and phenotypic levels, while number of fruits per plant and TSS were positively correlated with yield at the genotypic level. It may be concluded that fruit yield per plant, number of fruits per plant, fruit length, fruit diameter, average fruit weight, acidity and TSS are the most promising characters for selection in tomato improvement programmes. The findings provide useful information for developing high-yielding and quality-rich tomato genotypes suitable for the agro-climatic conditions of Rajasthan. Key words: Variability, Quality traits, Heritability, Genetic advance, agro climatic conditions, Correlation analysis , TSS.

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"Modern Irrigation Systems: Enhancing Water Efficiency for Sustainable Agriculture"

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Global agriculture faces pressing challenges due to water scarcity, changing climatic conditions, and the need for efficient resource use. Modern irrigation systems offer a pathway to transform agricultural water management in alignment with the vision of FutureAG 2025. This paper highlights the potential of advanced irrigation technologies like precision irrigation, drip irrigation, and smart irrigation systems to enhance water efficiency, reduce waste, and boost crop productivity. It discusses opportunities for employment in agri-tech sectors, the role of renewable energy in powering irrigation systems, and challenges such as high initial costs, skilled labour needs, and the requirement for supportive policy frameworks.

The findings suggest that integrating modern irrigation systems with sustainable practices, supported by government incentives, can serve as a cornerstone of climate-resilient agriculture. It holds the promise of bridging the gap between water availability and agricultural demand, ensuring food security, and creating a technologically empowered farming system for future generations.

Keywords: Modern irrigation systems, sustainable agriculture, water efficiency, precision irrigation, climate resilience, food security, FutureAG 2025

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"CLIMATE CHANGE AND SIMULATIONS"

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Climate change is one of the most pressing global challenges of the 21st century, with far-reaching consequences for ecosystems, economies, and human societies. Driven largely by anthropogenic emissions of greenhouse gases (GHGs), climate change manifests in the form of rising global temperatures, sea level rise, extreme weather events, and loss of biodiversity. In recent decades, simulation models have become essential tools in climate science, providing valuable insights into the complex dynamics of Earth's climate system and informing policy and mitigation strategies.

This study explores the role of simulation in understanding the impacts of climate change and evaluating potential mitigation and adaptation scenarios. Using a combination of climate models, such as General Circulation Models (GCMs), and regional climate simulations, the research investigates future climate projections under various emission pathways outlined by the Intergovernmental Panel on Climate Change (IPCC). Additionally, the study incorporates socio-economic data and land-use models to simulate the broader implications of climate change on water resources, agriculture, and urban systems.

Key words :- Global warming ,Green House gases(GHGs),Extreme weather events Adaptation strategies , Climate -smart agriculture 2025.

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Farmer Producer Organizations as Catalysts for Collective Action: A Case Study of Smallholders in South Gujarat

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India's agrarian economy continues to rely heavily on small and marginal farmers, who constitute over 85 percent of agricultural landholders. These farmers face persistent challenges such as fragmented landholdings, lack of economies of scale, weak bargaining power, and inadequate access to timely markets and fair pricing. In response, Farmer Producer Organizations (FPOs) have emerged as a promising institutional model to strengthen farmers' collective capacity by facilitating access to inputs, credit, capacity-building programs, and organized marketing channels. The present study was conducted in South Gujarat with the objective of examining the socio-economic profile of small and marginal farmers associated with FPOs, their attitudes towards FPO services, and the constraints they encounter in participation. Employing a descriptive research design, primary data were collected from 450 member farmers across 15 FPOs using a structured questionnaire, and the results were analyzed through statistical techniques, including Garrett's ranking method. The findings revealed that a majority of respondents were middle-aged (70%), educated up to the secondary level (56%), and classified as small farmers (54%). Income enhancement (71.11%), better price realization (69.33%), and rapid payment settlements (64%) were the foremost reasons for joining FPOs. Attitudinal analysis indicated that 63.78 percent of farmers expressed a favourable outlook toward FPO services, with education, mass media exposure, and prior FPO experience emerging as strong determinants of positive perception. However, the study also highlighted key constraints such as lack of storage and processing infrastructure, non-availability of timely credit, high market competition, and distant market access coupled with high transportation costs. The study suggests that FPOs hold considerable promise in enhancing the livelihoods of smallholders; however, targeted interventions in infrastructure development, institutional credit access, and governance mechanisms are essential to maximize their impact and ensure lasting sustainability.

Keywords: Agriculture, Small and marginal farmers, Farmer Producer Organizations (FPOs), South Gujarat, Socio-economic profile, Farmer attitudes, Constraints

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Foliar application of Chlormequat Chloride is an effective remedy for early and uniform flowering during stress break conditions in Mrig crop of Nagpur mandarin (Citrus reticulata Blanco) under Satpura plateau region of district Pandhurna Madhya Pradesh.

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Breaking the seasonality of Nagpur mandarin for commercial production would not only substitute the import of fresh fruits, but also provide the incentive prices to the Nagpur mandarin growers. Withholding water, root exposure and root pruning are the common practices adopted to regulate flowering. In recent years, Chlormequat chloride, a growth retardant, has been used with considerable success to induce early and uniform flowering for off-season production in several fruit crops. Mandarin trees are exposed to water deficit stress by withholding water for about 30-45 days before expected flowering. Many times, this stress is untimely broken due to climate change related untimely rains resulting in sparse or no flowering due loss of flowering stimulus due to untimely rains. Therefore, to assess the effectiveness of Chlormequat chloride, in *mrig bahar* during stress break periods of Nagpur mandarin plants the foliar application with 2000 ppm and 3000 ppm was done. Chlormequat chloride, a plant growth retardant, is used to improve uniform flowering in Nagpur mandarin by inhibiting gibberellin biosynthesis, which leads to reduced vegetative growth and enhanced flower yield. It results in stronger, more compact plants and can induce earlier flowering, contributing to more manageable plant structures and potentially improving crop resilience. It works by inhibiting the production of gibberellins, that promote stem elongation, slows cell elongation, leading to shorter, sturdier plants with reduction in vegetative growth redirects the plant resources, often resulting in an increased number of flowers and overall early and uniform flowering to maximize the quality fruit production. Phytophthora root rot and gummosis are the most important soil borne diseases of Nagpur mandarin causing mortality,slow decline and yield loss of mature treesPhytophthora root rot and gummosis are the most important soil borne diseases of Nagpur mandarin causing mortality,slow decline and yield loss of mature trees

Key words: Chlormequat chloride, Stress, Mrig bahar, Foliar application, retardants

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Ocular Infrared Thermography as a Non-Invasive Stress Assessment Tool in Cross-Bred Heifers: Association with Serum Cortisol and Physiological Responses

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Heat stress poses a considerable risk to animal welfare and productivity, underscoring the necessity for precise and non-invasive monitoring techniques for efficient management. This study examines the feasibility of ocular surface temperature (OST) assessed by infrared thermography (IRT) as a biomarker for thermal stress in cattle. OST was documented at three ocular locations—the inner canthus (EYETi), central ocular surface (EYETc), and outer canthus (EYETo) in crossbred (Karan Fries) heifers throughout three separate seasons: winter, spring, and summer. Physiological measures, including rectal temperature (RT), respiration rate, and serum cortisol levels, were simultaneously evaluated to assess heat stress. Among all the ocular regions, the EYETi region demonstrated the most consistent and responsive thermal variation across seasons, with higher mean temperatures of 33.53 ± 0.30°C in winter to 35.96 ± 0.14°C in spring, and reaching a peak at 40.02 ± 0.17°C during summer in KF. These values corresponded with seasonal increases in RT (from 100.68 °F to 102.72°F) and serum cortisol levels, which were highest during summer, particularly in Karan Fries, indicating heightened heat sensitivity in them. Strong correlations were observed between EYEi temperature and established stress indicators, including RT ($r = 0.89$, $p < 0.001$), respiration rate RR ($r = 0.92$, $p < 0.001$), and serum cortisol level ($r = 0.88$, $p < 0.001$). These findings show EYEi temperature serves as a reliable, non-invasive indicator for assessing cattle heat stress, reinforcing IRT's value in animal welfare monitoring and breed-specific studies of thermotolerance.

KEY WORDS: climate change, ocular temperature, heat stress, bovine.

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EARLY DIAGNOSIS OF PEST ACTIVITY IN UNDERGROUND CROPS THROUGH PH SENSING TECHNIQUES

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Pest infestation is one of the primary causes of yield reduction in underground crops such as carrot, potato, radish, and beetroot. These crops are particularly vulnerable due to the difficulty in visually detecting early signs of pest activity, as most of the damage occurs below the soil surface. Traditional pest detection methods often involve manual inspection or the use of chemical indicators, which are time- consuming, labor-intensive, and sometimes harmful to the environment. Therefore, there is a pressing need for a more efficient, non-invasive, and environmentally friendly method for early pest detection.This research focuses on the identification of pests in underground or root-based crops by analyzing the variation in pH levels within the plant or surrounding soil. The fundamental hypothesis is that pest activity alters the plant's physiological and biochemical processes, which in turn affects the pH level of plant tissues and the rhizosphere (the soil zone influenced by root secretions). By monitoring these pH changes, it is possible to detect the presence of pests before visible symptoms or severe damage occur.The study involved controlled cultivation of underground crops under both pest-free and pest-infested conditions. Continuous pH monitoring was carried out using soil probes and plant sap analysis to identify any significant deviations caused by specific pest species. The results indicated a measurable difference in pH levels between healthy and infested plants, with certain pests producing a unique pH signature. These findings suggest that pH monitoring can be used as an indirect indicator for pest detection.The proposed method offers several advantages: it is non-destructive, cost-effective, and can be integrated with existing precision agriculture systems for real-time monitoring. This approach also contributes to more sustainable farming practices by enabling early intervention, thereby reducing the need for broad-spectrum pesticide application and minimizing environmental impact.

Key words: Underground crops, Pest detection, pH level monitoring, Carrot, Potato, Soil-plant interaction, Rhizosphere pH, Root crop health, Non-invasive diagnostics, Precision agriculture, Sustainable farming, Early pest identification, Biochemical markers, Plant stress response.

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EFFECT OF CHILLED STORAGE ON QUALITY CHARACTERISTICS OF BATTERED AND BREADED SHRIMP FINGERS PREPARED FROM KIDDI SHRIMP (PARAPENAEOPSIS STYLIFERA) (H. MILNE EDWARDS, 1837)

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This study was performed to determine quality changes of battered and breaded pre- fried shrimp fingers developed from kiddi shrimp (Parapenaeopsis stylifera) stored at chilled temperature (0 0 C to 4 0 C). Quality changes were assessed based on biochemical, microbiological and sensory quality evaluation at one day interval for a period of 20 days. Results of biochemical analysis showed increase in Total Volatile Base-Nitrogen (TVB-N) values from initial value of 2.43 to 32.42 mg/ 100 g, TMA value increased from 8.81 to 10.41 mg/100g and pH increased from 6.51 to 6.89 during 20 days of chilled storage. In microbiological quality evaluation total plate count (Log. Values) increased from 2.43 to 4.51, while Escherichia coli, Staphylococcus aureus and Salmonella were absent during the storage period. Results of sensory analysis reported a negative correlation with storage period concluding the shelf life of battered and breaded shrimp fingers to be 14 days at chilled storage conditions.

Keywords: Shrimp fingers, P. stylifera (Tiny shrimp), Shelf life, Quality changes

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Enhancing Nutritional Quality through Development of Anthocyanin-Rich Radish Lines

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Radish (*Raphanus sativus L.*) is a fast-growing root crop valued for its crisp texture and pungency. Beyond its culinary importance, radish is gaining prominence as a functional food due to bioactive compounds such as anthocyanins, which impart red–purple pigmentation and strong antioxidant activity. However, most cultivated varieties possess low and unstable anthocyanin levels. In the present study, diverse pigmented germplasm lines were evaluated to identify and develop anthocyanin-rich genotypes. Wide variability was recorded in root pigmentation, with total anthocyanin content ranging from 18.6 to 62.4 mg cyanidin-3-glucoside equivalents/100 g fresh weight. Selected lines exhibited up to a 2.5-fold increase over commercial checks. Antioxidant activity, estimated through DPPH radical scavenging, varied from 42% to 78% inhibition, showing strong correlation with anthocyanin concentration ($r = 0.81$). Promising genotypes combined intense pigmentation with desirable horticultural traits, recording root yields between 18.2 and 24.6 t/ha under protected cultivation. Stability analysis across two seasons indicated consistent anthocyanin accumulation, with minimal seasonal fluctuations (<10%).

Through recurrent selection and targeted hybridization, elite breeding lines with uniform pigmentation and enhanced nutritional quality were developed. These anthocyanin- rich radish genotypes not only diversify dietary options but also hold potential for functional food and nutraceutical industries.

Keywords: Radish, anthocyanin, antioxidant activity, nutritional enhancement, breeding

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Role of Epibreeding in Sustainable Climate Resilience Crops

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Climate-resilient crops with improved adaptation to the changing climate are urgently needed to feed the growing population. Epigenetics is the sum total of the heritable changes in phenotype, independent and irrespective of the genotype. By modulating plant development and physiological responses to environmental conditions, epigenetic diversity naturally, genetically, chemically, or environmentally induced can help optimize crop traits in an era challenged by global climate change. Plant epibreeding is the utilization of epigenetic variation for crop development, and has a wide range of applications in the field of crop improvement by crossing wild plants with these are produced by crossing mutants having hypomethylated DNA (met1 and ddm1) EpiRIL with wild plants. EpiRILs are recombinant inbred lines derived from parents that have identical genetic makeup but they differ in DNA methylation. Diverse classes of enzymes have been studied duly pertaining to the four main systems running in the background viz., DNA methylation processes, histone modifications, chromatin remodeling, Piwi interacting RNAs, RNA silencing and Combined bisulfite restriction analysis (COBRA), Chromatin Immuno-precipitation method (ChIP) and DNAase I seq resulting in epigenetic modifications and the eventual constitution of epigenomes. The improvement in agronomic traits through epigenetics is found in many crops including rice, Arabidopsis, maize, soybean, rapeseed, etc. Epigenetics contributes to phenotypic variation. Thus, understanding epigenetics and epigenomics can aid in elucidating the mechanisms through which environmental factors influence the phenotypes. Breeders may be able to combat the ongoing issue of genetic erosion and uncover cryptic variation through the use of the existing epigenetic variability or epigenome modification.

Keywords: Epigenetics, DNA, Methylation, RNA silencing, Genetic Erosion

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Distribution of Extended Spectrum Beta-Lactamase Producing Escherichia coli from Clinical Samples of Livestock and Companion Animals

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A total of 681 Escherichia coli isolates from clinical samples of cats and dogs (Dog diarrhoea=457, Dog wound swabs=7, Dog abscess=24, Otitis media= 3, Cat diarrhoea= 4, Cat wound swabs= 8, Cat abscess=4, Goat diarrhoea=67, Cattle diarrhoea=47, Poultry diarrhea=110) isolated between the year January, 2015 to April, 2025 were characterized for their bla^{ESBL} genes, and other resistant genes respectively. A total of 124 isolates (18.20%) were confirmed as bla^{ESBL} producers, where, isolates 71(57.25 %) for bla^{TEM} , 25(20.16 %) for bla^{CTX-M} , and bla ^{SHV} 7 (5.64%) were positive for bla^{ESBL} genes. For other resistant genes, isolates 6 (4.83%) for *tet*A, 3 (2.41%) for *tet*B, 13 (10.48 %) for aac(3')*IIa* and 3 (2.41%) for aac(6')*Ib* genes, 2 (1.61%) for *qnr* were the positive genes detected. Antibiotic sensitivity tests of all the isolates revealed that 66.07% of the isolates were resistant to Ampicillin, 76.50% of the isolates were susceptible to nitrofurantoin. Genotyping using Repetitive Extragenic Palindromic-Polymerase Chain Reaction (Rep-PCR) of the bla^{ESBL} isolates showed a distinct and similar clonality among the E. coli isolates of companion animals.

Keywords: *Escherichia coli, ESBL, clinical isolates, Rep-PCR*

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Evaluation of bold nut cashew genotypes(*Anacardium occidentale L.*)

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The experiment entitled **"Genetic variability studies on bold nut cashew (*Anacardium occidentale L.*) genotypes"** was conducted during the year 2023-2024 at Cashew Research Station (CRS), Odisha University of Agriculture and Technology, Bhubaneswar, Odisha. Twenty cashew genotypes, planted in the year 2019, were assessed for genetic variability, correlation, divergence and per se performance . The study was designed using Randomized Block Design (RBD) with two replications, with four plants per genotype planted at a spacing of 6m x 6m. Standard cultivation practices were applied throughout the experiment to ensure optimal growth and development of the genotypes. Evaluation of cashew genotypes for yield attributes and nut yield revealed significant genetic variability among the genotypes. The phenotypic coefficient of variation (PCV) was greater than the genotypic coefficient of variation (GCV) across all traits during evaluation. Heritability was recorded maximum for traits like fruit weight (96.64%), nut weight (96.57%) and apple weight (95.37%). Nut yield along with other key yield components such as fruit weight and kernel weight, displayed positive correlations with various plant traits. Path analysis highlighted nut weight (76.713) as the most influential trait directly affecting nut yield. The findings also suggest that cluster analysis can effectively group genotypes with similar genetic backgrounds, with cluster-II emerging as the most promising group for yield improvement due to its high nut yield. Evaluation of twenty genotypes for per se performance revealed that genotype B-code stands out with the highest canopy spread in both the East-West and North-South directions, along with the highest shelling percentage (32.39%). Genotype M-code excels in apple weight (189.63 g) and fruit weight (201.04 g), highlighting its potential for high fruit production. Genotype, S-code recorded the highest nut weight (14.14 g), but its performance in other traits was moderate. Genotype, Q-code recorded maximum mean annual nut yield (3.24 kg tree -1) at 3rd harvest, making it a top choice for maximizing yield. Altogether, genotypes, B- code and Q-code emerged as the best performer in nut yield, positioning these genotypes as promising candidates for breeding programs aimed at yield improvement and enhanced productivity, while genotype M- code is notable for its fruit production.

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Genetic and environmental influences on fatty acid composition in different fenugreek genotypes

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SEED OFFICER

RAJASTHAN STATE SEED CORP LTD JAIPUR

Fenugreek (*Trigonella foenum-graecum L.*) plays a crucial role in both the food and pharmaceutical industries due to its rich nutritional profile and medicinal properties, such as regulating blood sugar and reducing inflammation. This study offers a comprehensive analysis of the fatty acid composition in fenugreek seeds, revealing significant variability influenced by genetic and environmental factors. The analysis showed that linoleic acid ranged from 32.16 % to 45.96 %, linolenic acid from 17.3 % to 31.21 %, oleic acid from 11.40 % to 20.32 %, stearic acid from 3.78 % to 6.76 %, and palmitic acid from 8.74 % to 16.44 %. Both genotype and environmental conditions had a profound impact on these profiles, with notable variations arising from differences in water availability. The Israel and Kermanshah (Iran) genotypes recorded the highest linoleic acid levels under irrigated conditions, while the Kayseri (Turkey) genotype exhibited the highest linolenic and stearic acid values across both irrigated and non-irrigated environments. Additionally, the Ahvaz (Iran) and Ukraine genotypes excelled in oleic and palmitic acid concentrations. Principal component analysis (PCA) and Additive Main Effects and Multiplicative Interaction (AMMI) biplots further highlighted the complex genotype-environment interactions, providing essential insights for breeding fenugreek varieties optimized for diverse agro-climatic conditions.

Keywords: *Trigonella foenum-graecum*;Genotype-environment Interaction Fatty acid; Stability ;Irrigation and rainfed.

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Genomic Selection: A Modern Approach for Crop Improvement

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Genomic selection (GS) has emerged as a revolutionary breeding strategy to accelerate crop improvement by predicting the genetic potential of plants using genome-wide marker information. Unlike traditional marker-assisted selection that focuses on a few major loci, GS captures the cumulative effects of both major and minor genes, thus enhancing the accuracy of selection for complex, quantitative traits such as yield, stress tolerance and quality attributes. By integrating high throughput genotyping with advanced statistical models and machine learning algorithms, GS enables breeders to make early and informed decisions without extensive multi- season phenotyping. This significantly reduces the breeding cycle, enhances genetic gain per unit time and improves resource efficiency. Furthermore, GS complements conventional breeding and biotechnological tools, providing a robust platform to address global challenges such as climate change, food security and sustainability. Its successful application in cereals, legumes and horticultural crops highlights its potential as a transformative tool in modern plant breeding.

Keywords: Genomic prediction, Marker-assisted breeding, Genetic gain, Plant breeding, Crop improvement

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Integrated Omics Approaches for Crop Improvement

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Integrated omics approaches have opened new frontiers in understanding the complex biological systems underlying crop growth, development and stress responses. By combining genomics, transcriptomics, proteomics, metabolomics and phenomics, researchers can generate a holistic view of gene-to-phenotype relationships. These approaches enable the identification of key regulatory networks, molecular markers and candidate genes associated with yield, nutritional quality and tolerance to biotic and abiotic stresses. Integration of multi-omics data, supported by bioinformatics and systems biology tools, enhances the accuracy of trait prediction and accelerates the discovery of novel targets for genetic improvement. Moreover, coupling omics with genome editing and precision breeding strategies provides powerful solutions to meet global challenges of climate resilience and food security. Thus, integrated omics approaches serve as a transformative platform to design next-generation crops with enhanced productivity and sustainability.

Keywords: Genomics, Transcriptomics, Proteomics, Metabolomics, Systems biology

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Effects of organic supplements and inorganic nutrients levels on productivity and profitability of maize in the Northeastern region

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The field study entitled Effects of organic supplements and inorganic nutrients levels on the productivity of maize in the northeastern region was conducted during the kharif season of 2023 at the Experimental Farm of ICAR–Indian Agricultural Research Institute (IARI), Assam. The experiment was laid out in a split-plot design. It consisted 3 organic supplements (Control, FYM @ 10 t/ha, and Vermicompost @ 2.5 t/ha) in main plots and four inorganic nutrients levels (control, 50% RDF, 75% RDF, and 100% RDF along with 300 kg lime/ha with all levels) in a subplot and replicated thrice. The experimental findings showed that among organic supplements, FYM @10 t/ha shows higher growth parameters, grain yield (4.37 t/ha), net returns (₹71040) and improvement in soil health. Among inorganic nutrients management levels, 100% RDF was superior in crop growth, grain yield (4.43 t/ha), and more profitable (net B: C 1.7) compared to other levels. There was a significant interaction between organic supplements and inorganic nutrients levels on the yields and economics of maize. The highest grain (4.84 t/ha), stover, and biological yields and the highest gross returns and net returns were obtained with the application of 10 t FYM/ha along with 100% RDF (NPK) compared to the other treatment combinations. The highest net B: C ratio was obtained by control with 100% RDF i.e., 1.85. Application of vermicompost @ 2.5 t/ha with 100% RDF (NPK) and FYM @ 10 t/ha with 75% RDF (NPK) were found remunerative and suitable to achieve maximum yield as compared to other treatment combinations. Among organic supplements, the significantly highest partial factor productivity (PFP) for N and P was obtained from the application of 10 t FYM/ha. Among inorganic nutrients levels, control recorded significantly higher PFP for N and P.

Keywords: FYM, Maize, Productivity, Profitability, Vermicompost.

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Influence of maturity stages and pre-processing methods on morphological, structural and functional properties of green banana flour.

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The growing global demand for functional food ingredients has driven significant interest in green banana flour modification. This research focus on the influence of various pre-processing modification methods (ultrasound (US), blast freezing (BF), clove oil (CO), dual modification (DM), and chemical treatments (KMS + Citric acid)) on the comprehensive characteristics of both immature and mature green banana flour. Key findings revealed that BF and US treatments were highly effective in altering the starch granular structure, reducing particle size, and significantly enhancing resistant starch content, with mature flour treated with US reaching a high of 41.67%. In contrast, CO treatment increased crystallinity, while a combination of KMS + CA resulted in more shear-thinning behaviour. Structural studies revealed O-H stretching vibrations near 3400 cm^{-1}, characteristic of starch, which differed between mature and immature modified flour. Immature bananas were found to have higher levels of soluble dietary fiber, total phenolics, and flavonoids. Furthermore, US and BF treatments were particularly beneficial in reducing the flour hydrolysis rate and glycemic index. These findings have substantial applications for the food industry, providing a means to utilize immature and export-reject bananas to produce nutritionally rich products. The modified banana flour is suitable for developing a wide range of functional foods, nutraceuticals, and low-glycemic index products, thereby addressing consumer demands for healthy food options and promoting sustainability by repurposing agricultural by-products.

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COMPREHENSIVE EXTENSION STRATEGIES GOVT. POLICIES FOR THE PROMOTION OF NATURAL FARMING

Roles and responsibilities of Community Resource Persons (CRPs) in mobilization, demonstration of natural farming to different cluster in India

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Community Resource Persons (CRPs) have emerged as pivotal agents in advancing natural farming across rural India, particularly through farmer-to-farmer extension models. As locally rooted practitioners, CRPs play a crucial role in mobilizing communities, fostering awareness, and organizing farmers into clusters that encourage collective learning and action. Their responsibilities extend beyond mobilization to encompass training and capacity building through on-field demonstrations, hands-on skill development, and the use of digital tools for knowledge transfer. CRPs also provide continuous handholding by offering technical support, troubleshooting, and monitoring adoption outcomes, often supported by digital platforms for real-time reporting. By leveraging local trust, knowledge, and leadership, CRPs ensure sustainability, community empowerment, and effective diffusion of natural farming practices, aligning grassroots efforts with national initiatives like the National Mission on Natural Farming. Role of CRPs includes farm made bio-cultures named ‘Jeevamrit, Beejamrit etc.’ are added to the soil instead of any fertilizers to improve microflora of soil. Krishi Sakhis/ CRPs deployed in each NF cluster are undergoing 2 rounds of training at the training institution linked with the respective cluster (KVK or AU or Local NF Institution). Farmer Capacity Building and Action Plan for CRPs Step-by-step approach to train farmers and support them through the transition process- Strategy for improving NF adoption in their clusters is quintessential. The policymakers must address challenges in CRP mobilization & engagement, difficulties in mobilizing farmers, addressing their doubts, and ensuring their participation in NF.

Keywords: Climate resilience; Data-driven Farming; Precision agriculture; Precision irrigation; Predictive analytics, SDGs, Smart Farming.

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Green Solutions for Clean Air: Understanding the Impact of Indoor Plants on Air Quality

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Indoor plants are commonly regarded as beneficial for enhancing indoor air quality, primarily through the mechanism of phytoremediation. Numerous studies have consistently shown that various plant species can effectively remove volatile organic compounds (VOCs) from enclosed environments, with pollutants such as formaldehyde, benzene, and trichloroethylene being absorbed through leaf stomata and subsequently degraded by microorganisms in the root zone. Nevertheless, the practical implications of these findings in actual indoor settings remain a topic of scientific discussion. Although plants contribute to the reduction of airborne pollutants, their clean air delivery rate (CADR) is often minimal when compared to the air exchange rates provided by standard HVAC systems or even open windows. The volume of air in a typical room and the continuous introduction of new pollutants frequently exceed the limited purification capacity of a few houseplants. Despite their modest impact on chemical pollutants, indoor plants offer substantial psychological benefits, including stress reduction, increased productivity, and enhanced overall well-being. Consequently, while indoor plants can be a valuable component of a healthy indoor environment, they should be considered a supplementary strategy rather than a primary solution for air purification, with adequate ventilation remaining the most effective method for maintaining high indoor air quality.

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Performance of Mungbean (*Vigna radiata L.*) Cultivars for Summer under Different Sowing Windows

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A field experiment entitled "Performance of Mungbean (*Vigna radiata L.*) Cultivars for Summer under Different Sowing Windows" was conducted at Agricultural College Farm, Bapatla during summer 2023–24 to evaluate the influence of sowing dates and cultivars on growth, yield and agrometeorological indices on mung beans. Results revealed that early sowing during the 2nd fortnight of January (D1) significantly enhanced growth attributes such as plant height, dry matter accumulation and crop growth rate compared to delayed sowing. Among cultivars, LGG-607 consistently recorded superior performance in terms of growth and yield attributes over LGG-460 and LGG-574. Seed yield was highest with D1 sowing (855 kg ha^{-1}) and lowest with March sowing (516 kg ha^{-1}), primarily due to favourable agro-climatic conditions in early sowing. Yield attributes such as branches per plant, pods per plant and seeds per pod were also maximized in early sowings and in LGG- 607. Agrometeorological indices including Growing Degree Days (GDD), Helio-Thermal Units (HTU) and Photo-Thermal Units (PTU) showed strong linear relationships with phenological stages and seed yield. The study highlights that timely sowing in January coupled with the cultivar LGG-607 optimizes productivity and climatic resilience of mungbean in the Krishna agro-climatic zone of South Coastal Andhra Pradesh.

Key words: Climate resilience, sowing windows, yield attributes, phenological stages

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The Integration of Information and Communication Technology (ICT) in Indian Agriculture

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The integration of Information and Communication Technology (ICT) in Indian agriculture has emerged as a transformative force, bridging critical gaps between farmers, markets, research institutions, and government agencies. ICT tools and platforms—such as mobile applications, e-governance portals, geographic information systems (GIS), and remote sensing—have enabled timely dissemination of agricultural information related to weather forecasts, market prices, pest and disease management, and modern farming techniques. These innovations have enhanced decision-making, increased productivity, and improved supply chain efficiency. Moreover, ICT facilitates access to financial services and government schemes, empowering small and marginal farmers. Despite infrastructural challenges and digital literacy barriers, ICT continues to play a vital role in promoting sustainable agriculture, rural development, and food security in India. The integration of ICT in Indian agriculture. The paper examines the role of ICT tools and platforms in enhancing agricultural productivity and efficiency in India. It also evaluates the challenges and barriers faced in implementing ICT solutions in rural and agricultural contexts, including digital literacy, infrastructure, and affordability.

Keywords: ICT, Indian Agriculture, Digital Farming, e-Agriculture, Precision Agriculture, Market Information Systems, Rural Development, Agricultural Extension, Smart Farming, Food Security.

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Role of Organic Farming in Enhancing Productivity, Quality, and Sustainability of Vegetable Crops

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Organic farming in vegetables has gained significance as a sustainable alternative to conventional agriculture, reducing dependence on synthetic fertilizers and pesticides. Application of organic manures such as farmyard manure, compost, vermicompost, and green manures improves soil structure, enhances microbial activity, and supplies macro- and micronutrients in a slow-release form, thereby sustaining crop growth and yield. Biofertilizers like Azotobacter, Azospirillum, and phosphate-solubilizing bacteria further support nutrient availability and uptake efficiency in vegetable crops. Such practices not only enhance soil organic carbon and nutrient dynamics but also contribute to improved water-holding capacity and long-term soil fertility.

In addition to soil health, organic farming improves the nutritional and quality parameters of vegetables. Organically grown produce is often reported to have higher ascorbic acid, carotenoids, and total sugars, along with lower nitrate accumulation, making them healthier and safer for consumption. Natural pest management strategies, including neem-based formulations, bio-control agents, and crop rotations, reduce pesticide residues while maintaining ecological balance. Although initial yields under organic systems may be comparatively lower, premium market prices, rising consumer preference, and long-term sustainability highlight the economic viability of organic vegetable production.

Key words: Organic farming, Vegetables, Soil health, Biofertilizers, Nutritional quality, Sustainability, Carbon sequestration, Pesticide-free produce, Ecological balance, Economics.

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Evaluation of Combining Ability for Seedling Growth Traits in Mulberry (*Morus Spp*.)

Kaveri Aramani

An experimental study on interspecific hybridization was carried out to evaluate combining ability effects for early growth traits in mulberry, employing six female and four male genotypes in a line × tester mating design at the Department of Sericulture, UAS, GKVK, Bengaluru during the year 2023–24. Seedling attributes were assessed under a completely randomized design (CRD) with three replications. The investigation demonstrated that,

Morus cathayana (ME-03) exhibited good general combining ability (GCA) for seedling height at 60 and 90 days after sowing (DAS; 2.225 and 4.011, respectively), number of leaves per plant (1.278) and fresh leaf weight per plant (1.629). Among the testers, M. indica (MI-0308) showed strong GCA for seedling height at 60 and 90 DAS (0.775 and 2.928, respectively), number of leaves per plant (0.644), internodal distance (-0.052) and fresh leaf weight per plant (1.378). The specific combining ability (SCA) effects of hybrids revealed that M. latifolia (ME-0185) × M. indica (MI-0173) performed best for germination percentage (3.146), M. bombycis (ME-18) × M. indica (MI-0308) for plant height at 60 and 90 DAS (3.383 and 6.000, respectively) and M. multicaulis (ME-06) × M. alba (MI-0423) for number of leaves per plant (1.694), single leaf area (27.978) and fresh leaf weight per plant (1.439), recording highly positive SCA effects. Hence, these parents and F1 progenies may be further used in breeding programs for mulberry crop improvement.

Keywords: Combining ability; General combining ability (GCA); Specific combining ability (SCA); Seedling growth traits; Genetic evaluation

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Market Information in Agribusiness

Anusha Ganti and Vaishali Chaturvedi

Market information refers to systematically collected data related to agricultural commodities, including prices, arrivals, quality, and demand-supply trends. This review focuses on the role and sources of market information in agribusiness, highlighting its critical importance in enhancing decision-making and market efficiency. Traditionally, market information was conveyed verbally or displayed on notice boards, but technological advancements such as mobile phones, SMS alerts, and farmer helplines have enabled widespread and timely dissemination of information, empowering farmers to make more informed decisions. Globally, countries like Kenya, Thailand, and the Philippines have adopted similar market information systems with support from the Food and Agriculture Organization (FAO). Both government and non-government agencies play key roles in generating market information, with NABARD, ICAR, and NSSO being prominent government institutions contributing to the collection and distribution of agricultural data. Additionally, digital platforms such as web portals, YouTube channels, and WhatsApp groups are increasingly used to deliver market information directly to farmers. This information enables farmers to strategically decide where and when to sell their produce, maximizing returns based on market prices. As digital tools and mobile platforms continue to evolve, the accessibility, accuracy, and relevance of market information are expanding, promising a more efficient, transparent, and equitable future for agriculture and agribusiness sectors.

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Integrating Remote Sensing and Crop Simulation Models for Climate-Resilient Cropping Systems

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Climate change poses a significant challenge to global food security by altering temperature patterns, precipitation regimes, and the frequency of extreme weather events. These changes directly affect crop growth, yield stability, and resource use efficiency. The integration of remote sensing technologies with process-based crop simulation models offers a powerful approach to monitor, predict, and mitigate the impacts of climate variability on agricultural systems. Remote sensing, particularly through satellite-derived vegetation indices such as NDVI, enables spatially explicit and timely assessment of crop health, phenology, and biomass across diverse agro-ecological zones. Crop simulation models, such as DSSAT and InfoCrop, complement these observations by simulating crop growth dynamics, yield potential, and nutrient–water interactions under varying climate and management scenarios. This chapter presents an overview of the synergistic use of remote sensing and crop models to enhance decision-making in climate-resilient agriculture. It discusses key methodological considerations, including data requirements, calibration, validation, and integration workflows. Examples from recent studies illustrate how these tools can be employed for early warning systems, site-specific nutrient management, and adaptation strategy evaluation. Emphasis is placed on the role of these integrated approaches in supporting precision agriculture, sustainable intensification, and policy formulation for climate adaptation. By bridging field-level measurements, satellite observations, and model-based projections, this framework provides stakeholders with actionable insights to improve productivity, optimize resource allocation, and enhance the resilience of cropping systems in the face of climate uncertainty.

Keywords: Climate resilience, Remote sensing, Crop simulation models, Precision agriculture, Sustainable intensification

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Organic Pathways to Sustainable Agriculture: Practices, Challenges, and Opportunities

Dr. Rizwan Ali

Organic farming is becoming more and more popular as a realistic route to food systems that are both economically and environmentally sound because of the push for sustainable agriculture. The fundamental methods related to difficulties and new prospects in organic farming as a strategy for achieving sustainability over the long run. The ecological and agronomic advantages of important organic methods are investigated, including crop rotation, composting, green manuring, biological pest management and avoiding synthetic fertilizers and pesticides. These techniques help to preserve biodiversity, increase soil health, lower greenhouse gas emissions and improve the quality of food. Organic farming has a number of challenges despite its potential, such as reduced crop yields compared to conventional systems, increased labour needs and restricted access to organic inputs and market restrictions for smallholder farmers. The wide variances in certification processes and governmental backing create disparities and difficulties for the international expansion of organic farming. Producers also frequently face logistical and financial challenges during the shift from conventional to organic farming. On the other hand, the growing demand from consumers for organic products, developments in agro-ecological research, encouraging laws and the incorporation of digital technology present substantial growth prospects. Productivity and market accessibility can be improved by developments in biological fertilizers, organic seed production and data-driven farm management. Although it is an essential part of a multifaceted approach to sustainable agriculture, organic farming is not a cure-all. Food security, environmental health, and rural development may all be significantly enhanced by organic farming with the help of comprehensive management, stakeholder participation, and supporting regulatory frameworks.

Keywords:Organic agriculture, sustainable farming, soil health, biodiversity, organic practices, environmental sustainability, food security, green manuring, biological pest control, rural development.

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Role Of ICT and FPO in Agriculture

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Agriculture continues to remain the backbone of rural livelihoods, especially in developing economies such as India where a majority of farmers are small and marginal. The sector faces persistent challenges such as fragmented landholdings, low productivity, lack of timely access to quality inputs, credit, extension services, and reliable markets. In this context, Information and Communication Technology (ICT) and Farmer Producer Organizations (FPOs) emerge as critical enablers of agricultural transformation. ICT tools—ranging from mobile-based advisory services, e-NAM (National Agricultural Market), weather forecasting systems, mobile banking, and precision farming—bridge the information and connectivity gap between farmers, markets, and policymakers. FPOs, on the other hand, strengthen the collective bargaining power of farmers by aggregating production, reducing transaction costs, and enabling better access to markets and finance. Together, ICT and FPOs create a synergistic model that empowers farmers with knowledge, organizational strength, and market linkages. This chapter explores the role of ICT in strengthening FPOs, highlights successful case studies, examines the challenges and limitations, and suggests future strategies for building resilient and digitally empowered farmer collectives.

Key Word: ICT, Farmer Producer Organizations, Digital Agriculture, Market Linkages, Rural Empowerment, Sustainable Farming.

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Spatial variability of Zinc content in soil and its relation with soil properties of Jaipur district region of Rajasthan

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Zinc (Zn) is an essential micronutrient required for the normal healthy growth and reproduction of plants, animals, and humans. This study assessed the status of available zinc and its spatial variability in soils of the Jaipur, it comes under Semi-Arid Eastern Plain agro-ecological zone of Rajasthan and examined its relationship with key soil physico-chemical properties. Sixty-five soil samples were collected randomly from different locations of Jaipur and analysed for pH, electrical conductivity (EC), organic carbon (OC), macronutrients (P, K, S), micronutrients (Fe, Cu, Mn), including DTPA-extractable Zn. The results showed predominantly alkaline soils (mean pH 7.96), low organic carbon (mean 0.36%), and considerable variability in zinc availability (mean 0.86 ppm), with nearly one-third of samples classified as zinc deficient. Correlation analysis revealed weak and mostly non-significant associations between Zn and soil parameters, except for a strong positive relationship with iron and negative relationship with soil pH . Geostatistical analysis showed that zinc had only weak spatial dependence and no clear spatial continuity, suggesting that its distribution is mainly shaped by localized variability and the influence of management practices. Regression modeling further confirmed the complexity and limited predictability of Zn availability from other soil properties. These findings highlight the necessity for regular site-specific monitoring and tailored zinc nutrient management strategies to mitigate Zn deficiency, improve soil fertility, and enhance crop productivity in semi-arid regions.

Keywords: DTPA-extractable zinc, soil physic-chemical properties, Correlation, geostatistical tool.

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Evolving Startup Ecosystems in Tier 2 And 3 Cities in India

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This study aims to analyze the growth trajectory and geographical dispersion of startups in India, with a particular focus on Tier 2 and Tier 3 cities. Using data from the DPIIT Startup India Report 2024, which includes over 1.57 lakh recognized startups and 17.28 lakh self-reported jobs, this research identifies key trends in sectoral expansion, gender inclusivity, and regional entrepreneurship dynamics. The paper finds that approximately 48% of recognized startups originate from Tier 2 and 3 cities, indicating a decentralization of innovation from metropolitan hubs to emerging urban centers. Regions such as North, South, and West India show consistent growth, with cities like Jaipur, Coimbatore, Nashik, and Ranchi becoming notable entrepreneurial hotspots. The study also highlights a 93% CAGR in startups with at least one-woman directors, showcasing increasing gender participation. Key industries such as IT Services, Healthcare & Life Sciences, and Education dominate the startup landscape, while changemaker sectors like Waste Management, Biotechnology, and Logistics have shown exponential growth post-2020. The study concludes with policy recommendations to sustain this momentum, including enhanced local incubation support, targeted funding schemes for high-potential districts, and gender-sensitive startup incentives.

Keywords: Entrepreneurship Ecosystem, Regional Innovation, Women Entrepreneurs, Changemaker Industries.

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Nutritional improvement of palmyra palm (*Borassus flabellifer)* through value addition

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Palmyra palm *(Borassus flabellifer*), popularly known as "Kalpaga Tharu," is an underutilized but nutritionally rich resource commonly found in Southern India. Despite being a state tree of Tamil Nadu and having multiple edible products such as *nungu* (tender endosperm), *neera* (sap), jaggery, tuber flour, and fruit pulp, commercialization is still limited due to lack of standardized value addition practices. In this study, an attempt was made to enhance the nutritional properties of palmyra through development of palmyra-based cookies using fruit squash as a functional ingredient. The methodology involved extraction of fruit squash from palmyra pulp, followed by incorporation at varying concentrations into cookies prepared with different base flours (maida, wheat, and ragi). Twelve treatments (T1–T12) were formulated and analyzed for their proximate composition (moisture, ash, fat, protein, carbohydrate, and energy) and selected mineral contents (Ca, Na, K, Fe, P, Mg). The results indicated that maida-based cookies had higher energy values (531.9 kcal/100g) with fat content of 28.85 g/100g, whereas wheat-based cookies were superior in protein (4.27 g/100g) and potassium content (227 mg/kg). Magnesium was significantly higher in maida cookies (874 mg/kgSensory evaluation showed strong consumer acceptability: 50.4% of respondents rated taste of maida cookies as “like extremely,” while 57.1% rated wheat cookies at the same level. In conclusion, incorporation of palmyra squash in cookies enhanced their nutritional value and delivered a distinctive flavor that was well accepted by consumers. The study demonstrates the potential of palmyra value addition as a means of agricultural diversification, improving food security, farmer income, and reducing over-dependence on staple crops like wheat and sugarcane. Further scaling can open commercial avenues for palmyra-based functional bakery products.

Keywords: Palmyra palm, Value addition, Functional cookies, Nutritional analysis, Sensory evaluation

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Aeroponics: Advanced Soilless Technique for Enhanced Crop Production

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Aeroponics is an advanced soilless cultivation method in which plants are grown with their roots suspended in the air and periodically misted with a nutrient-rich solution, enabling optimal moisture and oxygenation for fast and healthy plant growth. This approach provides precise control over humidity, temperature, pH, and water conductivity, often under greenhouse conditions, allowing cultivation in diverse environments and making efficient use of cubic space.

Aeroponics differs from conventional agriculture by eliminating soil or aggregate media; instead, plant roots are sprayed with atomized nutrient solutions in a controlled environment, typically inside greenhouses or specialized chambers. This system provides direct access to oxygen and water while minimizing disease risk and promoting efficient uptake of nutrients.

Aeroponics boasts several benefits, including accelerated crop growth rates, water conservation and an ability to precisely control environmental variables such as humidity, temperature and nutrient supply. These systems are especially suited to high-density, vertical farming in urban environments where space and resources are limited. Commercially, aeroponics is used for crops like potatoes, tomatoes and leafy greens, and has applications in plant research, seed multiplication and even bio-pharming. Aeroponics promises increased yields and sustainability, its adoption is limited by high setup and operational costs, the need for skilled management and infrastructure challenges. Maintenance, such as mist nozzle cleaning and nutrient solution management, is essential to prevent system failures and ensure optimum plant health.

Overall, aeroponics represents a highly innovative and efficient method of modern agriculture, offering solutions for food production in areas with limited arable land and water, and paving the way for future advances in sustainable farming and plant science.

Key Words: Aeroponics, Environment, Greenhouse, Media, Mist and Sustainable.

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Studies on Propagation of Pomegranate (*Punicum Grantum L)* By Step Cuttings

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Pomegranate can be propagated through seeds, but the problem is poor seed setting and viability. Hence, its propagation through seeds on a commercial scale is difficult. We have to go for vegetative method of propagation and this crop could be propagated by cuttings because of its latticiferous nature. In this experiment hard wood cuttings were treated with different growth regulators *viz.*, IBA, NAA, at different concentrations and the rooting response and further establishment in the field were observed. The results of the experiment are discussed here undermining the treatments IBA @ 500 ppm Borax 1 % - 15 minutes (T_4) recorded the highest rooting percentage (88.54 %). The highest number of roots (6.54) per cutting was observed in the cuttings dipped in (T_4).Cuttings treated with (T_4) had recorded maximum root length (68.00 cm). (T_4) had recorded the highest mean fresh weight of roots 3.67 g. The dry weight of roots was found to be maximum in the cuttings treated (T_4) (1.75g). (T_4) had recorded the minimum time taken for the first sprout to appear (15.02 days). Among the various growth regulators, the cuttings treated with (T_4) had recorded the maximum number of leaves per shoot 60.35.(T_4) had recorded the maximum number of leaves (169.80) per cutting. Among the various growth regulators the cuttings treated with (T_4) had recorded maximum fresh weight of shoots (5.65 g) and dry weight of shoots (3.38 g).The cuttings treated with IBA @ 500 ppm +Borax 1 % -15 minutes (T_4) had recorded maximum leaf length (7.52 cm) per cutting. Maximum field establishment percentage was recorded in the cuttings treated with (T_4) (90.84 %).Finally it could conclude that the higher rooting of cuttings and maximum field establishment of rooted cuttings could be obtained by application of IBA @ 500 ppm + Borax 1% -15 minutes in pomegranate.

Keywords: IBA- Indole Butyric Acid, NAA- Naphthalene Acetic Acid, ppm- Parts Per Million.

ISBN: 978-93-344-1457-8 **FA/2025/082**

Valorization of grape winery waste: Optimization of Drying conditions and green technologies for bioactive compounds extraction

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Valorization of grape waste, a by-product of the winery industry, has gained attention recently as it can help reduce environmental impact while adding value to the winemaking process by recovering a range of biologically active compounds. In the present study, the effects of different drying methods and optimization of green technologies on the extraction and stability of bioactive compounds from grape winery waste were investigated. Further, the most effective method, vacuum drying, was optimized to maximize the extraction of bioactive compounds for potential use in the development of functional foods. Vacuum drying at 60 °C for 3 hours showed the highest retention of all bioactive compounds i.e. 30060 mg/100 ml anthocyanins, 12160 mg/100 ml flavonoids, and 18140 mg/100 ml phenolics, along with 4.22% RSA antioxidant activity followed by tray drying, shade drying, and direct sun drying. After the selection of the best drying method, optimization of green extraction technology has been performed to seek the maximum extraction of bioactive compounds from grape waste. The UAE of grape waste was carried out at 59°C for 15 minutes, MAE was carried out at 900W for 1 min. and EAE was carried out using enzymes pectinase and β-glucanase reaction mixture. After the extraction process, bioactive compounds in terms of anthocyanins, flavonoids, antioxidants, and total phenols were quantified. Hence, the best extraction conditions resulted in the highest concentrations of bioactive compounds viz.,507.86 mgGAE/100ml total phenols, 200.12mg/100ml flavonoids, 6.6mg/100ml antthocyanins, 90.08%RSA (Radical Scavenging Activity) antioxidants by DPPH method in the grape waste where an experimental design Principal components bi-plots (PCA) was performed for the maximum extraction of bioactive compounds. Therefore, the study demonstrates that grape winery waste dried by the vacuum drying method offers an attractive alternative for revalorizing this by-product using the microwave assisted green technology maintaining high levels of bioactive compounds, and providing scalable, economically viable solutions for the winery industry.

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Productivity Analysis of Small Tea Growers in Assam: A Study on Two Selected Districts of Assam.

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The Assam tea industry is a major contributor to India's economy and the global tea market, with small tea growers playing a crucial role in its development. The sector serves as a key source of employment for a significant portion of the rural population in the state. Assam boasts the largest area under small tea gardens in India, with registered small tea growers accounting for 55% of the country's tea garden area and contributing over 42% of India's total tea production (Tea Board of India, 2020). In 2023, small tea growers in Assam produced approximately 700 million kilograms of green tea leaves. Tea cultivation in Assam is characterised by varying landholding sizes, categorized into small, medium, and large estates. Small Tea Growers (STGs) typically operate on landholdings of up to 10.12 hectares (approximately 25 acres or 75 bighas) (Tea Board of India). This study aims to analyze the production behaviour and productivity of STGs in Assam. Two districts from one agro-climatic zone were selected based on the highest and lowest numbers of STGs in the districts. The total sample size comprised 354 STGs, representing 1% of the growers in each district. The productivity analysis employed the Production Accounting Model developed by H.S. Davis (1955). The findings revealed notable variations in productivity across zones and districts in terms of land, labour, and capital efficiency. Additionally, the number of high-productivity STGs was found to be low in both districts. These insights highlight the need for targeted interventions to enhance productivity in the region.

Keywords: Small Tea Growers, production, productivity, development, cost of production, land holding etc.

ISBN: 978-93-344-1457-8 **FA/2025/084**

Study the pathogenicity of Aeromonas caviae in the Piaractus brachypomus in an experimental fish disease model.

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This study systematically evaluated the pathogenicity of Aeromonas caviae in Piaractus brachypomus (pacu) through experimental challenges, histopathological analysis, and haematological profiling. Pacu fingerlings (10 ± 2 g) were acclimatized and intraperitoneal injected with graded doses of A. caviae to determine lethal dose (LD50) values. Clinical signs, mortality, and haematological (RBC, WBC, haemoglobin) and serum biochemical markers (glucose, albumin, SGOT, SGPT) were monitored. Histopathological changes in gill, liver, and kidney tissues were assessed. Results revealed that LD50 values of and 2.15 × 108 CFU/ml for A. caviae. Infected fish exhibited haemorrhagic lesions, lethargy, and ataxia, with severe haematological disruptions like significantly decreased haemoglobin level, total erythrocyte count, platelet count, and an increase in total leucocyte count. Serum biomarkers indicated significantly decreased glucose level, SGPT, SGOT increased level, and decreased albumin level. Histopathology confirmed extensive tissue damage, including gill lamellar fusion, hepatocellular necrosis, and renal haemorrhage. This study highlights the vulnerability of P. brachypomus to Aeromonas infections and provides critical LD50 data for risk assessment in aquaculture systems. The findings underscore the need for targeted health management strategies for P. brachypomus in the process of developing sustainable production models that can be replicated across tropical aquaculture systems worldwide.

Keywords: LD_{50}, A. caviae, glucose, albumin, Histopathology.

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Effect of Pelletized Biofertilizer Consortia on Rooting, Growth, and Economic Viability in Mulberry (*Morus indica* L.)

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A pot culture experiment was conducted at the Department of Sericulture, Forest College and Research Institute, Tamil Nadu Agricultural University, Mettupalayam, India, between February and May 2024, to evaluate the effect of pelletized biofertilizer formulations on quantitative traits and economic feasibility of mulberry (*Morus indica* L. cv. V1) cuttings. The study, laid out in a factorial randomized complete block design with ten treatment combinations, involved pellet formulations prepared with Orgafol, NAA, and microbial inoculants (*Azospirillum*, Phosphobacteria, and VAM), applied at planting. Observations recorded up to 75 days after planting showed significant variations among treatments, with T9 performing best by recording the highest rooting percentage (79.75%) and survival rate (91.60%), followed by T10. Root and shoot lengths (38.99 cm and 50.08 cm, respectively), number of leaves (13.42), and leaf area (160.82 cm^2) were also maximum in T9, whereas the control (T1) consistently showed the lowest values. Economic analysis revealed that each pellet cost ₹0.128 to produce and sold at ₹0.60, yielding a net daily profit of ₹516.84 at a production scale of 2000 pellets/day, with a Benefit-Cost ratio of 1.8, indicating high profitability. These findings demonstrate that pelletized biofertilizer formulations integrating microbial inoculants and growth regulators significantly enhance rooting, growth, and economic returns in mulberry propagation, offering a viable and sustainable technology for commercial nursery practices.

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Digital Farmer Field Schools: Community-Driven Agricultural Transformation by PAANI Foundation in Maharashtra

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The Digital Farmer Field Schools (Digital Sheti Shalas) initiative by the PAANI Foundation exemplifies a pioneering, community-centric approach to sustainable agriculture in Maharashtra. Launched in collaboration with State Agricultural Universities(SAU's) and the Government of Maharashtra, this initiative offers free, subject expert-led sessions to farmers across the state, utilizing digital platforms like Zoom and YouTube to ensure widespread accessibility. The model enables thousands of farmers including women and marginalized communities to regularly engage with over 120 agricultural scientists, receiving real-time guidance on more than 36 crops, natural resource management, pest control, and climate-resilient practices. By forming farmer groups and pooling resources, the Digital Sheti Shalas foster social cohesion and empower rural communities to tackle agricultural challenges collaboratively. Training is designed to be interactive, combining field demonstrations, games, and data-driven methods to cultivate both practical skills and financial literacy for example, record keeping, cost management, and joint procurement of inputs for maximum savings and collective selling of produce for maximum profit . The integration of digital education with grassroots mobilization has led to measurable impacts: a 70% rise in crop productivity, over ₹15,000 reduction in per-acre cultivation costs, and a 163% increase in per-acre profits, as validated by independent studies. Moreover, the PAANI Foundation's approach prioritizes water conservation, soil health, and ecological restoration, helping villages build climate resilience and reduce migration triggered by drought. By 2026, the Digital Farmer Field Schools are set to reach all 350 blocks of Maharashtra, potentially impacting lakhs of rural families and transforming livelihood prospects at scale. This blend of digital innovation, scientific rigor, and people-powered action presents a scalable blueprint for rural development, where technology, community, and knowledge coalesce for agricultural prosperity.

ISBN: 978-93-344-1457-8 **FA/2025/087**

Estimation of Heterosis in Pigeonpea [*Cajans cajan* (L.) Millps.] Using Half-Diallel Mating System

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Thirty-six hybrids generated from eight parents through half diallel mating design were tested for determining heterosis. The analysis of variance of individual environments revealed significant differences among all the genotypes, parents and F_1s for all the traits thus, indicating the presence of substantial amounts of genetic variability among the genotypes. Three most positive standard heterotic crosses *viz*., ICPL-20338 x ICPL-20340, ICPL-20338 x AL-882 and Pusa-992 x PA-16, identified for seed yield and its contributing traits on the basis of standard heterosis against standard check PAU-881, respectively. These can be exploited commercially for heterosis breeding in pigeonpea.

Key Words: - Half diallel mating, Standard heterosis, Pigeonpea

ISBN: 978-93-344-1457-8 **FA/2025/088**

Silkworm Litter based Liquid Organic Manure: A Sustainable Approach to Soil Fertility and Microbial Enrichment in Mulberry Cultivation.

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Mulberry (*Morus* sp.) is a deep-rooted high biomass producing foliage crop which is the sole food source for silkworm, *Bombyx mori* L. With the increasing demand for sustainable agricultural practices particularly in rearing silkworms with chemical free mulberry leaves, the use of organic inputs has gained attention as an alternative to synthetic fertilizers. To explore the effectiveness of silkworm litter as liquid organic manure a study was conducted at the Department of Sericulture, UAS, GKVK, Bengaluru, during 2023-24. The results of the experiment revealed that the Silkworm litter based liquid organic manure (SLLM) had slightly alkaline pH (7.68) with notable nutrient content *viz.*, NPK (3.02 %, 1.22 %, 2.96 % respectively) and micronutrients Fe (1,116.20 ppm), Zn (73.80 ppm), Cu (14.10 ppm) and Mn (268.60 ppm). The study also explores the effectiveness of SLLM at different doses along with Recommended Dose of Fertilizers (RDF) in enhancing soil nutrients and microbiota. The treatment RDF + Soil drenching of 250 l $acre^{-1}$ of 20 % SLLM at 10 Days after pruning (DAP) + Foliar spray of 150 l $acre^{-1}$ of 10 % SLLM at 25 DAP (T_9) recorded maximum organic carbon content (0.82 %), NPK content (413.80, 32.43, 254.07 kg/ha respectively), micronutrients *viz*., Fe (2.72 ppm), Zn (2.64 ppm), Mn (32.06 ppm) and Cu (0.92 ppm) along with maximum soil bacteria (51.83 X 10^6 cfu g^{-1}), fungi (6.50 X 10^2 cfu g^{-1}) and actinomycetes (61.20 X 10^4 cfu g^{-1}) besides suppressing pathogen load. This shows that application of SLLM to soil in mulberry gardens serves as an eco-friendly and efficient organic amendment for improving soil fertility and productivity in sericulture based agroecosystems contributing to both organic sericulture and circular bio-resource management.

Keywords: Silkworm litter, Liquid manure, Mulberry, Soil fertility, Soil microbiota.

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Assessment of Marigold Hybrid Arka Abhi Over Local Practice

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The present investigation was conducted at six locations of Andhra Pradesh for two consecutive years 2023-24 and 2024-25, mainly to assess the yield and quality performance of two hybrids of marigold (Arka Abhi and Arka Bhanu) developed by IIHR at farmers' field by comparing with farmers practice (Maxima Yellow). The experiment spanned for two consecutive years and took place in five villages and six locations within Krishna district, as part of the On Farm Trial organized by Krishi Vigyan Kendra, Ghantasala, Acarya N G Ranga Agricultural University. All the packages of practices were followed as per recommendation. The results indicate significant variations among the genotypes. Arka Abhi produced lemon yellow, Arka Bhanu produced golden yellow and Maxima yellow produced vibrant yellow blooms, respectively. The compactness and number of flowers produced were higher in Arka Abhi compared to other two hybrids. The average yield for the two consecutive years was observed highest in Arka Abhi (TO1) as 24.88 t/ha. followed by 23.45 t/ha in Arka Bhanu (TO2) and finally 22.79 t/ha in farmers' practice (TO3). There was a yield increase of 9.17 % in TO1 compared to TO3 and 6.1 % compared to TO2. While, comparing the average net returns and Benefit cost ratio in the three hybrids, it was observed highest in TO1 with Rs 4,21,388 /- (2.61 BCR), followed by TO2 with Rs 3,84,359/- (2.47 BCR) and Rs. 345463/- was obtained in TO3 with 2.32 BCR. In conclusion, Arka Abhi produced compact blooms with high yield compared to farmers' practice.

Key words: Marigold, Arka Abhi, Arka Bhanu, net returns

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Applications of High-Throughput Tools in Mulberry Physiology Research

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Sericulture is the multi- dimensional activity and Mulberry (*Morus* spp*)* is the sole food for silkworm *Bombyx mori.* It is very important to study the physiology of mulberry for the betterment of sericulture productivity and screening of better performing lines to withstand biotic and abiotic stress. High through-put screening can be defined as the automation of experiments such that large scale repetition becomes feasible. It is necessary to monitor the crop growing status continuously and non-destructively to make decisions as to changed environmental conditions. Recent advances in high-throughput tools have transformed the study of mulberry physiology, enabling rapid, precise, and large-scale measurement of key functional traits. This present paper synthesizes availability and application of some of the high-throughput platforms including, Leaf area meter, chlorophyll fluorescence imaging, Portable Photosynthetic System (PPS), hyperspectral and multispectral sensing, thermal imaging, UAV-based remote sensing, and imitating structures in evaluating photosynthesis, stress tolerance, nutrient status, and leaf quality in mulberry. Emphasis is placed on how these tools facilitate early stress detection, genotype screening, and integration with molecular datasets for precision breeding. Case studies highlight their use under drought, waterlogging, nutrient imbalances, etc. To conclude, thus high-throughput phenotyping not only enhances physiological understanding but also offers a pathway to accelerated mulberry improvement programs, bridging the gap between research and practical sericulture applications.

Keywords: Mulberry, High-Throughput phenotyping, Physiology, PPS, Fluorescence, Thermal imaging.

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Farm Household Income by Farm Size in India: Evidence from NSSO

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This study examines the relationship between farm size, income, and income diversification among agricultural households in India using unit-level data from the National Sample Survey Office (NSSO), 77th Round (2018-19). Results show a strong positive association between farm size and income, with marginal farmers earning the least and large farmers earning nearly seven times more. However, most households, regardless of landholding, depend on multiple income sources, reflecting the importance of diversification in sustaining livelihoods. The Simpson Index of Diversification (SID) indicates higher diversification among small farmers and lower among large farmers, while Gini indices reveal notable income inequality within each farm size group, especially among medium farmers. Tobit regression results highlight that age, education, work ing-age members, Landholding size, member attended training, Member of farmer organization, social group significantly influence diversification. Overall, the findings suggest that diversification remains essential, particularly for marginal and small farmers, as farm income alone is insufficient to secure livelihoods.

Keywords: Farm income,Non-farm income, Tobit regression, SID, Gini coefficient

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Management of termite, *Odontotermes obesus* (Blattodea: Termitidae) using entomopathogenic nematodes as potential biocontrol agents

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Odontotermes obesus is a notorious polyphagous pest of agricultural and horticultural crops, forests, and urban structures. It is characterized as a wood eating species and is widely spread out across the world. A major pest of economically important crops such as tea, sugarcane, cotton, castor, wheat, maize and cereals, management of *O. obesus* is extremely difficult owing to its enigmatic feeding behaviour and history of development of resistance to chemicals insecticides like bifenthrin, fipronil, cypermethrin, etc. Out of all the biocontrol agents targeted for the management of *O. obesus*, Entomopathogenic nematode (EPN) has drawn global attention in the last few decades because of their high host specificity, good host searching capacity and high pathogenicity. EPNs, especially local isolates, have registered greater potential in managing significant insect pets because of their compatibility to their native habitats. In the current study, two native isolates of EPN, *Heterorhabditis bacteriophora* and *Steinernema aciari* have shown significant potential as biocontrol agents against *O. obesus.*

Keywords: Biocontrol agents, entomopathogenic nematodes, *Heterorhabditis bacteriophora*, *Odontotermes obesus*, *Steinernema aciari*

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Analysis of the Environmental Parameters of Hydroponic Crop Grown under Polyhouse Conditions in Different Seasons

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A study was conducted on Basil (*Ocimum Basilicum*) crops grown under Polyhouse hydroponics in different seasons by controlling the environmental parameters at Dr. NTR College of Agricultural Engineering, Bapatla. The research work conducted for four seasons i.e., Season1(April and May), Season2(August and September), Season3(October and November) and Season4(January to February) on environmental parameters is presented in this paper. The environmental parameters were tried to be controlled to maintain a proper relative humidity range, i.e., 60-75%, a temperature below 30 °C, and CO_2 levels of 600 to 1500 ppm. The controlled environment and observations recorded by using Rotronic CP11'for crop analysis purpose. This makes a good quality and disease-free crop production. The final results reveal that the highest yield was 41.7 kg in season1, followed by 40.5 kg in season2, 38.9 kg in season3, and 36.2 kg in season4. The lowest yield of all the seasons was 36.2 kg in season4. Ultimately, the experiment showed that the basil crop grows in good health throughout Season1 and then again during Season2. Polynomial equations were fitted for the humidity and temperatures maintained inside the hydroponic polyhouse which are discussed in this paper. R^2 values between 0.5 and 0.7 were obtained for all the fitted equations. According to the study, yield is positively correlated with temperature and negatively correlated with relative humidity and carbon dioxide.

Key words: Hydroponics, Environmental parameters, Rotronic CP11, Polynomial Equation

ISBN: 978-93-344-1457-8 **FA/2025/094**

Effect of integrated nutrient management on vegetative growth of tuberose (*Polianthes tuberosa* L.) cv. Prajwal.

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The present investigation entitled "Effect of integrated nutrient management on the flowering attributes of tuberose (*Polianthes tuberosa* L.) cv. Prajwal." was conducted during the year 2022-2023 and 2023-2024 in the Experimental farm at Department of Horticulture, SAS, Nagaland University, Medziphema Campus, Nagaland. The trial was laid out in randomized block design consisting of twelve treatments with three replications. The treatments include a combination of recommended doses of fertilizers along with the organic manures such as the farm yard manure, vermicompost, poultry manure, forest soil, and humic acid. Among the various treatments, the plants receiving a combination of 75 % RDF + Vermicompost @ 5 t ha^{-1} (T_4) was found to be best in all the vegetative parameters, viz., minimum days to sprouting (9.23), maximum number of leaves per plant (23.78), length of leaves (47.96 cm), plant height (56. 94 cm), number of side shoots per plant (6.05), and highest total chlorophyll (0.429 mg/g) content on leaves. It is concluded and recommended that 75 % recommended dose of fertilizer and @ 5 t ha^{-1} vermicompost should be applied for significant results of vegetative growth in tuberose.

Keywords: Tuberose, farm yard manure, vermicompost, poultry manure, forest soil, and humic acid.

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Assessment and integration of Indigenous Technical Knowledge (ITK) for innovative aquaculture practices in West Bengal

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There is growing recognition of how important Indigenous Technical Knowledge (ITK) is for sustainable development, especially in aquaculture. While modern fish farming often uses advanced technology, research shows that traditional methods from local communities can be effective, affordable, and better for the environment. These practices, developed over generations, help create more resilient and sustainable fisheries. This study evaluates Indigenous Technical Knowledge (ITK) practices among fishing communities in West Bengal, India, using both quantitative and qualitative research methods. Experts assessed their scientific rationality, while fishers reported on effectiveness and adoption rates. Six previously undocumented ITK practices were also examined qualitatively to provide detailed insights into their mechanisms and ecological foundations. The findings show that most practices, specifically 11 out of 18, are scientifically rational, effective, and widely adopted, which highlights their practical value and cultural significance. The qualitative analysis of unique ITKs, such as the use of Keora fruit for Panga's catfish capture and the Eggshell Firefly trap, reveals advanced ecological knowledge and innovative methods. The study concludes that validating and integrating effective ITKs can promote sustainable aquaculture and improve rural livelihoods. Integrating traditional knowledge with scientific evaluation supports informed and culturally appropriate fisheries management. This multi-dimensional approach, which incorporates both scientific and socio-economic perspectives, provides nuanced insights for policy development and a diverse academic readership.

Keywords: Sustainable Aquaculture, Socio-economic factors, Qualitative analysis, Scientific rationality, Effectiveness, Rural livelihood

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Improving Quality Traits of Emmer Wheat (*Triticum dicoccum* L.) through System of Wheat Intensification

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A field experiment entitled "Improving quality traits of Emmer Wheat (*Triticum dicoccum* L.) through System of Wheat Intensification" was conducted at the Research Field of Ugar Khurd, Belagavi, Karnataka, during *rabi* 2022-23. The experiment was laid out in a split-plot design with three replications. The main plots consisted of two genotypes, Gokak Local and DDK-1029, each with and without seed priming, while the sub-plots included four planting geometries: S_1-30 × 15 cm, S_2-45 × 15 cm, S_3-20 × 20 cm and S_4 -20 cm (RPP). Seed priming with a bio-formulation (water, cow dung, cow urine, jaggery and curd in the ratio of 2.0: 0.5: 0.5: 0.1: 0.05, respectively) significantly improved quality traits such as protein content (%), yellow pigment (ppm), sedimentation value (ml), wet and dry gluten content (%), total gluten content (%), gluten index, hardness index, grain hardness (kg/grain), grain lustre, water binding capacity (%), test weight (kg/hl), flour recovery (%), moisture content (%), iron (ppm) and zinc (ppm) compared to unprimed seeds. Among the planting geometries, differences were not statistically significant; however, numerically higher values of quality parameters were recorded with the 30 × 15 cm geometry, followed by 45 × 15 cm.

Keywords: Emmer wheat, Plant geometries, Quality traits, Seed priming, SWI

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Exploring Millet-Based Functional Foods and Nutraceuticals for Health Promotion

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Millets, ancient grains traditionally consumed in Asia and Africa, are increasingly recognized for their exceptional nutritional profile and potential in functional foods and nutraceuticals. These climate-resilient crops are rich in dietary fiber, essential minerals (iron, calcium, magnesium), and bioactive compounds such as polyphenols, flavonoids, and phytosterols. These components contribute significantly to their health-promoting properties, including antioxidant, anti-inflammatory, and prebiotic activities. Scientific studies demonstrate that millets effectively support metabolic health by regulating blood glucose levels, reducing LDL cholesterol, and improving lipid profiles. Their high fiber content promotes gut health by serving as a prebiotic, fostering beneficial gut micro-biota and enhancing digestive function. Beyond their role as dietary staples, millets are being transformed into nutraceutical products through advanced extraction technologies like supercritical fluid extraction and ultrasound-assisted extraction. These processes isolate and concentrate bioactive compounds for formulation into capsules, tablets, and fortified foods. However, challenges such as bioavailability limitations and sensory characteristics need addressing through traditional processing methods like fermentation and malting. The growing consumer demand for natural, plant-based, and sustainable food products positions millets as an ideal ingredient for future functional food development. Realizing their full potential requires collaborative efforts across agriculture, research, industry, and policy sectors, with focused research on human clinical trials, standardization, and consumer acceptance. Millets represent a promising convergence of traditional wisdom and modern nutritional science, offering sustainable solutions to contemporary health challenges.

Keywords: Millets, functional foods, nutraceuticals, metabolic health, bioactive compounds, sustainability, prebiotics.

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Hydroponics: A Controlled Environment Agriculture for Advancing Food and Farming for Sustainable Future"

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Climate change possesses significant challenges to the global cultivation of vegetable crops, necessitating innovative agricultural practices. Hydroponics – a sustainable horticultural approach where plants are cultivated in nutrient-rich water without soil is emerging as a critical component of smart farming The present study was undertaken to evaluate the performance of lettuce (cv. Phule Padma) under different hydroponic systems. The research was conducted at RCSM College of Agriculture, Kolhapur. The experiment consisted of eight treatments: Ebb and flow, NFT Vertical , Wick method, Deep water culture, Drip and Drain method, NFT Slanting, NFT Horizontal and Pot cultivation. The treatments were arranged in a Completely Randomized Design with three replications. Five representative plants from each treatment were selected for recording observations at weekly intervals post-transplanting. Results revealed that hydroponic systems under controlled environmental conditions significantly overperformed traditional methods in terms of germination rate, growth and yield. Among all systems, Drip and drain recorded the highest vegetative growth with leaf length of 14.85 cm, plant height of 24.97 cm, and 14.53 leaves per plant, along with superior plant spread (28.50 cm) and leaf width (5.49 cm). In terms of N (4.10 %), P (0.52 %), K (4.99 %), Fe (100.67 mg/kg) and Ca(1.43 %). Drip and drain harvested very early as compared to other systems within 35 DAT showed earliness characteristics, topped in sensory attributes such as texture, crispiness and firmness rating. In terms of yield, Drip and drain gives maximum fresh weight per plant (252.35 g). In conclusion, the Drip and drain method emerged as the most effective hydroponic system for lettuce cultivation, offering superior biochemical quality, sensory appeal, and nutritional value, making it highly suitable for commercial urban farming. Despite the head formation being more pronounced in open field conditions due to the variety's characteristics, hydroponic systems, especially the Drip and drain method demonstrated significant advantages, confirming their potential as a sustainable, high-efficiency alternative for year-round lettuce production.

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Characterization of Arbuscular Mycorrhizal Fungi and Endophytic Bacillus in Tomato roots and their Antagonism against Fusarium Wilt

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Tomato (*Solanum lycopersicum L.*) is a widely grown vegetable in Meghalaya, ranking after potato. Fusarium wilt, caused by *Fusarium oxysporum f. sp. lycopersici* (FOL), is a major soil-borne disease leading to wilting and yield loss. Arbuscular mycorrhizal fungi (AMF), associated with 80-90% of plants, along with Bacillus endophytes, are known to promote growth and suppress soil-borne pathogens. A total of 41 AMF species were recovered, with Daistong showing the highest species richness (15 species). The most abundant species were *Funneliformis mosseae, Glomus aggregatum, and G. intraradices, while F. mosseae, G. intraradices, G. aggregatum, G. fasciculatum, G. australe, and F. badium* had >50% isolation frequency. Among the dominant species screened for tomato growth promotion in pot experiments, *F. mosseae* and *G. fasciculatum* performed best in enhancing plant and mycorrhizal parameters. A total of 130 endophytic Bacillus were isolated from tomato roots across 20 sites in Meghalaya. Based on biochemical tests, morphology, and ABIS online identification, isolates belonged to Bacillus, Paenibacillus, and Viridibacillus, with 17 each tentatively identified as B. amyloliquefaciens and B. thuringiensis. Twelve isolates showed strong inhibition (>27%) of *Fusarium oxysporum f. sp. lycopersici* (FOL) in dual culture, with ERBS51 (58.43%) and ERBS10 (55.68%) being the most effective. Further tests confirmed their antagonistic activity and PGP traits, including enzyme production, siderophore, ammonia, and phosphate and zinc solubilization. 16S rRNA sequencing identified ERBS51 as B. velezensis and ERBS10 as Bacillus sp., with other isolates as *B. subtilis, B. cereus, B. swezeyi, and B. subtilis subsp. spizizenii*. Pot and field trials showed that combined application of AMF (*F. mosseae, G. fasciculatum*) with ERBS51 and ERBS10 significantly reduced wilt (77.44% pot, 66.74% field) and enhanced growth and yield. The consortium offers a promising integrated approach for managing Fusarium wilt in tomato.

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Impact of egg albumen fortified mulberry leaves on rearing and cocoon characteristics of silkworm, *Bombyx mori* L. (FC1 × FC2) double hybrid

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The fortification of mulberry leaf with egg albumen and its impact on commercial characteristics of silkworm, *Bombyx mori* was conducted at College of Temperate Sericulture Mirgund SKUAST-K during spring season. The silkworm double hybrid (FC1 × FC2) was reared on mulberry leaves fortified with aqueous egg albumen solutions *viz.*, 5%, 10%, 15% and 20% daily once during fourth and fifth instar. The egg albumen fortified leaves improved all the rearing and cocoon characteristics of the silkworm. Among these concentrations the 20% egg albumen significantly improved all the parameters recording lowest total larval duration (25.33 days), highest weight of ten mature larvae (57.96g), cocoon weight (2.32g), shell weight (52.65cg) and shell percentage (22.52%). As the eggs are readily available to the farmers, these can be used during silkworm rearing for significantly improving the growth and development of silkworms resulting eventually in enhanced quality cocoon yield.

Keywords: Silkworm, FC1 × FC2, egg albumen, fortification, significant, cocoon yield

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Physio-biochemical insights into potato varietal resistance against potato virus Y disease

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Potato (*Solanum tuberosum* L.), a major member of the Solanaceae family, is cultivated globally as both a staple vegetable and a cash crop. Viral infections are among the most damaging constraints to potato production, with more than 40 viruses reported to infect the crop. Among these, Potato virus Y (PVY) is one of the most destructive, causing yield losses of up to 80% under severe epidemics. The present study evaluated physio-biochemical responses of four potato varieties *viz*., Kufri Bahar, Kufri Pushkar, Kufri Pukhraj, and Kufri Khyati against PVY infection at 60 days after sowing. Several parameters included chlorophyll (Chl), carotenoids, anthocyanin, total phenols, flavonoids, relative water content (RWC) and relative stress injury (RSI) were assessed. The greatest reduction in Chl content was recorded in Kufri Khyati, whereas Kufri Pukhraj exhibited the lowest reduction. PVY infection significantly enhanced anthocyanin, total phenol, and flavonoid contents, with the highest increase in Kufri Khyati (39.8%), followed by Kufri Bahar (25.4%), Kufri Pushkar (20.1%) and the lowest in Kufri Pukhraj. The accumulation of these metabolites may be associated with plant defense and stress tolerance mechanisms. RWC was comparatively higher in Kufri Pukhraj (19.23%), followed by Kufri Pushkar (17.91%) and Kufri Bahar (16.97%), while Kufri Khyati recorded the lowest (15.46%). Conversely, RSI increased under PVY infection, ranging from 28.47-31.67% in diseased leaves compared with 20.77-22.59% in healthy leaves. The maximum RSI was observed in Kufri Khyati (51.60%), while Kufri Pukhraj showed the minimum (26.03%). These findings indicate distinct varietal responses, highlighting Kufri Pukhraj as comparatively more tolerant and Kufri Khyati as more susceptible to PVY infection.

Keywords: Potato, Potato virus Y, biochemicals, defense mechanism, varietal resistance

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Role of technology in improving mushroom cultivation practices among small farmers

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Mushroom cultivation has become an attractive and sustainable livelihood option for small and marginal farmers due to its low land requirement and high economic returns. Despite this potential, conventional practices often restrict productivity, quality, and profitability. This paper examines the contribution of technology in enhancing mushroom cultivation, emphasizing innovations such as low-cost mushroom production units, simple climate regulation techniques, improved substrate management, and mobile-based advisory services. The integration of scientific spawn production methods, solar-assisted drying for value addition and modern packaging solutions has improved both yield and marketability. Evidence from rural case studies illustrates how technology-driven interventions not only raise production efficiency but also support waste recycling, resource conservation, and environmental sustainability. The study underscores that affordable, accessible, and farmer-friendly technologies can significantly strengthen the income security of small farmers while promoting resilient and sustainable mushroom-based farming systems.

Keywords: Mushroom cultivation, small farmers, sustainable livelihoods, low-cost technology, spawn production, climate control, value addition, mobile advisory services

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Zinc Finger Proteins Mediated Responses to Abiotic Stress in Plants

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Zinc finger proteins (ZFPs) are one of the largest transcription factor families in plants, universally conserved and representing 16–18% of total plant transcription factors. They regulate diverse biological processes including development, phytohormone signaling, and responses to environmental stresses. Among different subclasses, C2H2-type ZFPs are the most extensively characterized for their roles in abiotic stress tolerance. Structural features such as the QALGGH domain, EAR repression motif, and L/Bbox regions underpin their ability to bind DNA/RNA, interact with proteins, and modulate transcription. Many studies revealed C2H2-ZFPs regulate drought, salinity, cold, oxidative, and osmotic stress responses through ABA-dependent, ABA-independent, and MAPK signaling pathways. Functional analyses in arabidopsis, rice, soybean, and wheat reveal their involvement in ROS scavenging, osmotic adjustment, and hormone-mediated signaling, thereby enhancing plant resilience. ZFPs as key regulators of growth–stress networks and promising targets for crop improvement. Discovering the structural–functional relationships and regulatory interactions will be vital for advancing stress-resilient agriculture.

Keywords: Zinc finger proteins, Transcription Factors, ABA Signaling, Abiotic Stress

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Artificial Intelligence in Plant Breeding for Crop Climate Resilience

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Artificial Intelligence (AI) refers to the simulation of human intelligence in machines, allowing them to perform tasks that typically require human intelligence. These tasks include learning from experience, solving problems, recognizing patterns, understanding natural language and making decisions. Machine Learning (ML) develops algorithms that learn to perform specific tasks based on a provided data set. Artificial intelligence (AI) is renowned for its prowess in big data analysis and pattern recognition, and is revolutionizing numerous scientific domains including plant breeding. Wider potential of AI tools in various facets of breeding, including data collection, unlocking genetic diversity within gene banks, and bridging the genotype–phenotype gap to facilitate crop breeding. Moreover, AI tools also hold promise for refining crop traits by improving the precision of gene-editing systems and predicting the potential effects of gene variants on plant phenotypes. Leveraging AI-enabled precision breeding can augment the efficiency of breeding programs and holds promise for optimizing cropping systems at the grassroots level. Machine learning like Random Forest, Support Vector Machines (SVM), Convolutional Neural Networks (CNN), Recurrent Neural Networks (RNN) and Bayesian Networks are used for modeling complex trait inheritance patterns and genetic analysis in plant breeding. Genome-Wide Association Studies (GWAS) is a statistical approach used to identify associations between genetic markers and plant traits. Deep Reinforcement Learning can be applied in optimizing crop management strategies and resource allocation. AI's critical role in developing climate-resilient and pest-resistant crops, ensuring that key staples like maize, wheat, rice, tomato, potato and cotton can meet global food security challenges effectively.

Keywords: Artificial Intelligence, Machine Learning, Plant Breeding, Climate resilient

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Evaluating *in vitro* Efficacy of Bio-agents and Fungicides against *Alternaria alternata* in Marigold Leaf Blight Management

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Marigold (*Tagetes* spp.) is a widely cultivated and commercially significant ornamental plant known for its easy cultivation and adaptability to various soil and climatic conditions. Among the numerous diseases affecting marigold, *Alternaria alternata* caused leaf blight is particularly destructive, leading to substantial qualitative and quantitative losses. The present study aimed to evaluate the efficacy of various bio-agents and fungicides in managing *Alternaria alternata* and minimizing cultivation costs. *In vitro* tests of bio-agents revealed inhibitory effects against the leaf blight pathogen, with *Trichoderma virens* showing the highest mycelial growth inhibition (62.88%), followed by *T. harzianum* (62.33%), *T. koningii* (52.88%), *T. hamatum* (43.04%) and *Aspergillus niger* (38.52%). *Pseudomonas fluorescens* (25.17%) and *Bacillus subtilis* (20.67%) demonstrated relatively lower mycelial growth inhibition. Fungicidal efficacy was also assessed *in vitro*, with all fungicides tested exhibiting significant inhibitory activity against *Alternaria alternata*. Among the systemic fungicides, Difenoconazole 25% EC, Hexaconazole 5% EC, Propiconazole 25% EC, Iprodione 50% WP and Tebuconazole 25.9% EC (each at 1000 ppm) showed complete inhibition of mycelial growth. Carbendazim 50% WP exhibited moderate inhibition (58.52%). Among contact fungicides, Copper hydroxide 77% WP (@ 2000 ppm) was the most effective, with 87.74% inhibition, followed by Mancozeb 75% WP (87.37%), Copper oxychloride 50% WP (87.11%), Captan 50% WP (84.82%), Zineb 75% WP (82.33%) and Chlorothalonil (76.60%). Combination fungicides, such as Hexaconazole 4% + Zineb 68% WP (@ 2000 ppm) showed complete inhibition of mycelial growth of pathogen followed by Carbendazim 12% + Mancozeb 63% WP (85.58%), Tebuconazole 50 % + Trifloxystrobin 25% WG (86.31%) and Metalaxyl 8% + Mancozeb 64% WP (66.86%) showed promising results. These findings provide insight into effective management strategies for marigold leaf blight with minimal cost.

Keywords: Marigold, Leaf blight, Bio-agents, Fungicides, Management

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Studies on Change Detection in Land Use/Cover of *Pennar* Subbasin in Andhra Pradesh using Satellite Data and GIS

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There is a rapid change in land use/cover (LULC) which drastically affects the environment, by flow of water, energy, greenhouse gases from the land to the atmosphere, deforestation etc. An attempt has been made to study the temporal changes of land use/cover for the years 2011 and 2020 to identify the changes in Pennar subbasin, Anantapur district of Andhra Pradesh. The study was carried out using ERDAS Imagine 2015 software with remote sensing data of Landsat 5 and Landsat 8 of 2011 and 2020, respectively. The study area was categorized into seven land use/cover classes namely reservoirs, waterbodies, agricultural lands, barren lands, fallow lands, built up lands and forest. Maximum Likelihood Classification (MLC) of supervised classification was used in the present research. The accuracy assessment was carried by calculating Kappa coefficient "Khat" statistics of the years 2011 and 2020. The results revealed that the annual rate of change (ARC) during 2011 to 2020 was in raising trend for agricultural lands, built up, barren lands, forest and water bodies by 9.49 km^2/yr (11.97%), 0.47 km^2/yr (1.63%), 1.09 km^2/yr (7.15%), 1.30 km^2/yr (2.17%) and 0.16 km^2/yr (0.59%), respectively. Furthermore, it was in decreasing trend for reservoir and fallow land with decrease by 0.07 km^2/yr (0.73%) and 12.47 km^2/yr (6.09%), respectively. These findings are useful for crop planning of an area as per availability of water resources.

Keywords: ERDAS Imasin, GIS, Landsat, LULC, MLC, Remote Sensing.

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Influence of urea-impregnated biochar from various feedstocks on growth and yield of cowpea

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This study assesses how urea-impregnated biochar made from different feedstocks affects cowpea (*Vigna unguiculata*) growth and yield in Punjab, India. Thirteen treatments total including absolute control, recommended dosages of fertilizer (RDN), and biochar made from rice husk, sugarcane, and charcoal at different nitrogen levels were used in the randomized block design experiment. Outperforming both charcoal and rice husk biochars, as well as treatments with inorganic fertilizers alone, the results showed that applying sugarcane biochar at 100% RDN consistently produced the highest values for growth parameters plant height (308.47 cm, leaf area index (7.96), chlorophyll index (58.52) and yield attributes viz., grain yield (2126.21 kg ha^{-1}), number of pods per $plant^{-1}$ (28.20). While concurrently decreasing bulk density and exchangeable acidity, biochar additions significantly enhanced the physicochemical characteristics of the soil, root nodulation, and nutrient uptake. These results highlight sugarcane biochar's potential as a sustainable soil amendment to boost cowpea yield, with important ramifications for resource-efficient agriculture and soil health management in subtropical areas.

Keywords: biochar, cowpea, RDN, control, urea impregnated biochar

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Physico-chemical and Thermochemical Profiling of Mulberry (*Morus spp.)* Clones for Sustainable Bioenergy Application: A PCA-based Selection Approach for Sustainable Bioenergy Application

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Energy demand in recent decades has surged due to rapid industrialization, population growth, and lifestyle changes, with rural India largely dependent on biomass fuelwood as an easily available and cheaper alternative to fossil fuels. The present study aimed to evaluate the physico-chemical and thermochemical characteristics of mulberry (Morus spp.) clonal genetic resources to assess their suitability as renewable feedstock for bioenergy and fuelwood applications. The research, conducted during 2023–2024 at the Department of Sericulture, Forest College and Research Institute, Mettupalayam, Tamil Nadu, followed a Completely Randomized Design (CRD), with statistical analysis using SPSS (version 23) and PCA with XLSTAT 24. Wood samples from seventeen mulberry clones, including Morus alba (MI-0674, ME-0174, MI-0145, MI-0211, MI-0828, MI-0300, ME-0169, MI-0034), Morus latifolia (MI-0665, ME-0006, MI-0783, ME-0168, MI-0549, MI-0632, MI-0818, MI-0845), and Morus laevigata (MI-0532), were analyzed for parameters such as moisture content, density, specific gravity, extractives, lignin, holocellulose, ash, volatile matter, fixed carbon, calorific value, higher heating value (HHV), and fuel value index (FVI) using standard protocols. Calorific value and HHV varied between 16.76–19.34 MJ kg^{-1} and 18.73–20.64 MJ kg^{-1}, respectively. PCA identified five principal components explaining 85.092% of total variance, with MI-0845, ME-0168, and MI-0674 showing superior bioenergy profiles, while clones such as MI-0845, MI-0674, MI-0034, and MI-0532 contributed across multiple components, reflecting their versatility and strong overall performance. Moisture content emerged as a key determinant influencing combustion efficiency and fuel quality, as higher levels reduced calorific value, efficiency, and increased operational costs. Overall, the findings highlight the potential of select mulberry clones as sustainable bioenergy sources, offering scope for their strategic integration into renewable energy and agroforestry systems, while also guiding breeding and selection strategies to enhance mulberry's role in meeting rising energy demands.

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EVALUATION OF GENETIC DIVERSITY AMONG DIFFERENT BREEDS OF CHICKEN FROM IN AND AROUND GUJARAT

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The Indian poultry industry is one of the most dynamic and fastest-growing segments of the agro animal-based industry. India is the world's third largest egg producer and fourth largest chicken meat producer. The commercial poultry population contributes 534.74 million out of 851.81 million total poultry population being the largest poultry market in the world. Genetic characterization assesses the genetic constitution of a breed/population of a species. This analysis found a total of 245 alleles across the 24 microsatellites. In the present study all 24 microsatellite loci were polymorphic. The number of alleles per locus among the polymorphic markers ranged from 3 (ADL 210) to 21 (ADL 136) in Mewari chicken. The mean number of observed alleles was found 10.208. The observed heterozygosity values ranged from 0.182 (ADL 39) to 0.927 (MCW 59) whereas the range of expected heterozygosity was 0.601 (ADL 210) to 0.926 (ADL 136). The average observed heterozygosity and expected heterozygosity value were found to be 0.560 and 0.810, respectively. The FIS value for all 24 microsatellite loci ranged from 0.088 (ADL 210) to 0.757 (ADL 39) with mean of 0.303. The PIC values ranged from 0.5032 (HUJ 2) to 0.9499 (ADL 136) with mean 0.8132 ± 0.026 indicating markers used were highly informative. The test for genetic equilibrium indicated that 22, microsatellite loci deviated significantly from Hardy-Weinberg Equilibrium from a total of 24 microsatellite loci in Mewari chicken. The average observed heterozygosity per locus among the polymorphic markers were 0.560, 0.526 and 0.556 for Mewari, Aravali, and Ankleshwar chicken breeds, respectively. The average expected heterozygosity per locus among the polymorphic markers were 0.810, 0.770 and 0.763 for Mewari, Aravali, and Ankleshwar chicken breeds, respectively. Across the three breeds, the global heterozygosity deficit (FIT) was 0.371, population differentiation index (FST) was 0.111 indicates that approximately 11.1% of the total genetic variation is caused by differences between Mewari, Aravali and Ankleshwar chicken breeds. The coefficient of inbreeding (FIS) across microsatellite loci for Mewari (0.280), Aravali (0.316) and Ankleshwar (0.299), which indicates that all three indigenous chicken breeds are in endangered state and show high inbreeding. Higher genetic distances and lower FST values were reported for all three breeds. Findings from AMOVA showed that the largest portion of the genetic variation in three indigenous chicken populations in India existed in individuals within the population (86%), however genetic variation was found among the populations 14% only. The Pairwise Population Matrix of Nei Unbiased Genetic Distance among Aravali, Ankleshwar and Mewari were indicated that the farthest distance relationship exist between Mewari and Ankleshwar chickens (1.488) while Aravali and Mewari have the closest (0.672). The phylogenetic tree manifested that Mewari and Ankleshwar were found farthest as compared to Aravali and Mewari which were closest amongst them. ii Husbandry Anand Agricultural University, Anand-388 001 Gujarat, India.

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From Conservation to Productivity: Managing Natural Resources in Agronomy

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Natural resources such as soil, water, biodiversity, and energy form the foundation of agronomic productivity. However, challenges like soil degradation, declining organic matter, nutrient imbalance, water scarcity, and climate variability threaten their sustainability. Integrated approaches to natural resource management (NRM) are therefore essential to maintain ecological balance and ensure long-term crop productivity. Conservation practices such as minimum tillage, residue recycling, crop diversification, and organic amendments enhance soil organic carbon, improve soil structure, and promote microbial activity (Sharma et al., 2019; Yadav et al., 2022). Integrated nutrient management (INM), which combines organic and inorganic sources, has been widely reported to improve nutrient-use efficiency, maintain soil fertility, and enhance crop yield while minimizing environmental impacts (Kumar et al., 2020).

Water is another critical resource in agronomy, and its efficient use has become increasingly important in the context of climate change. Adoption of micro-irrigation systems, rainwater harvesting, and mulching helps improve water-use efficiency and ensures better crop resilience under water-limited conditions (Patel et al., 2021). Similarly, resource-conserving practices such as site-specific nutrient management, precision agriculture, and integrated weed management reduce input wastage and sustain yields. Agroforestry and cover cropping further contribute to biodiversity conservation, carbon sequestration, and ecological resilience (Choudhary et al., 2020).

Overall, natural resources management in agronomy is not only about conserving soil and water but also about integrating diverse, eco-friendly practices into farming systems. While constraints such as high initial costs, lack of awareness, and policy gaps remain, the long-term benefits of sustainable resource management-improved productivity, ecological stability, and enhanced farmer livelihoods-underscore its importance. Future strategies must emphasize farmer-friendly technologies, participatory approaches, and climate-smart practices to ensure sustainable and resilient agronomic systems (Meena et al., 2023).

Key words: Natural resources, Food, Future, Agronomy, Productivity

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Impact Assessment of Front Line Demonstrations on Taramira Productivity and Profitability

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Taramira *(Eruca sativa*), also known as rocket salad, is a hardy, drought-tolerant winter oilseed crop predominantly cultivated in the arid and semi-arid regions of north-western India. Despite its adaptability to rainfed conditions and poor soils, the crop has traditionally suffered from low productivity due to the continued use of outdated local varieties and conventional farming practices. To overcome these limitations and demonstrate the potential of modern agricultural technologies, the All India Coordinated Research Project (AICRP) on Oilseeds (Taramira Unit) at SKNAU, Jobner conducted Front Line Demonstrations (FLDs) during the 2018–19 *rabi* season. A total of 20 demonstrations were carried out across farmer fields using improved taramira varieties RTM-1355 and RTM-1351 in comparison with local farmer practices. These demonstrations incorporated a full package of recommended agronomic practices, including timely sowing, line sowing for better plant spacing, seed treatment to prevent seed-borne diseases, balanced fertilizer application as per soil test recommendations, and integrated pest and disease management. The improved varieties under recommended practices achieved grain yields ranging from 1085 to 1230 kg/ha, representing a yield advantage of 17.68% to 28.84% over the farmer's traditional practices, which produced only 875 to 1024 kg/ha. In addition to yield improvements, economic analysis of the demonstrations revealed a substantial increase in profitability. The gross and net returns were higher under improved practices, with a benefit-cost (B:C) ratio ranging from 3.54 to 4.29, clearly indicating superior economic viability. These results highlight the effectiveness of transferring scientific knowledge to the grassroots level through FLDs.

Keywords: FLD, Rainfed, Taramira, Variety, Yield

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Climate Change, Pathogen Evolution,and the Future of Crop Protection

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Crop output is the foundation of global food security, but plant diseases drastically reduce agricultural productivity and threaten to undermine its sustainability. Climate change – increased temperatures, changes in humidity, and modified patterns of precipitation - plays a role in changing pathogen dynamics. There is a danger of extensive epidemics due to these environmental changes since they not only increase the virulence of pathogens but also broaden their geographic range. The possibility of disease outbreaks is further increased by the increasing frequency of extreme weather events, which fosters an environment that is ideal for epidemics. In this regard, predicting plant diseases has become essential for crop protection, resource optimization, and reducing financial losses. Forecasting makes preventive management techniques possible by predicting the onset of disease and changes in its severity. However, because it speeds up pathogen evolution, modifies host-pathogen interactions, and encourages the emergence of novel strains in new areas, climate change makes prediction efforts more difficult. This increases the urgency and complexity of timely and accurate forecasting. The estimated requirement to boost the world's food supply by 50% by 2050 in order to feed the expanding population adds to the urgency. Additional concerns come from climate-related issues like the melting of the Himalayan glaciers, which jeopardizes over a quarter of Asia's food production and reduces water availability. Plant infections continue to cause an estimated 10–16% loss in yields globally, highlighting the continued vulnerability of agriculture even while improvements in pest and disease control have doubled global food output over the previous 40 years. Plant disease dynamics are influenced by a variety of environmental conditions, such as temperature, light, water availability, soil fertility, wind patterns, and atmospheric gases like CO_2 and methane. The three most important factors influencing future pathogen behavior are CO_2 concentration, water availability, and temperature.

Keywords: Climate Change, Host-Pathogen Interactions, Global Food Security, Pathogen Evolution

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Yield Response of *Bt*-Cotton Varieties to Different Sowing Dates under Changing Weather Patterns

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Cotton (*Gossypium hirsutum* L.), belonging to the Malvaceae family and the genus *Gossypium*, is highly responsive to its growing environment, with sowing time playing a vital role as a non-monetary input influencing growth and yield. Timely sowing ensures optimal crop establishment and development, whereas early or late sowing can negatively affect plant growth and productivity. Early sowing may lead to poor germination and stand establishment, while late sowing can expose the crop to low-temperature stress during later stages, both resulting in reduced yields .To evaluate the effect of different sowing dates and Bt-cotton varieties on yield, a field experiment was conducted at the research farm of Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana, during the Kharif seasons of 2023 and 2024. The study used a split-plot design with three sowing times 3rd week of May (D_1), 4th week of May (D_2), and 1st week of June (D_3) and four Bt-cotton varieties V_1 (RCH 773), V_2 (NCS 9013), V_3 (US51), and V_4 (ACH 177) replicated three times. Results showed that the crop sown in the 3rd week of May produced the highest yields, with yield per plant reaching 89.8 gm (2023) and 92.7 gm (2024), and yield per hectare recorded at 2010 kg/ha (2023) and 2178 kg/ha (2024) biological yield 8271 kg/ha (2023) and 8674 kg/ha (2024). Similarly, V_4 (ACH 177) emerged as the top-performing variety, with yield per plant of 90.2 gm (2023) and 90.4 gm (2024), and yield per hectare of 1980 kg/ha (2023) and 2159 kg/ha (2024) biological yield 8475 kg/ha (2023) and 8898 kg/ha (2024). Weather patterns played a significant role, with higher temperatures and rainfall in 2024 contributing to improved yields. Positive correlations were observed between cotton yield and both maximum and minimum temperatures, suggesting that increased temperatures within an optimal range can enhance productivity. In conclusion, the study indicates that sowing Bt-cotton in the 3rd week of May, particularly using the ACH 177 variety, offers the best yield performance . Moreover, favourable climatic conditions such as adequate rainfall and moderate temperatures substantially support higher cotton yields, reinforcing the importance of aligning agronomic practices with environmental conditions.

Keywords- Weather patterns, temperatures, rainfall, productivity

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Organic Farming with Residue-Free Production: Challenges and Prospects in India and Beyond

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Organic farming has gained substantial recognition as a sustainable agricultural practice due to its focus on environmental preservation and consumer health. Central to organic farming is the goal of residue-free production, where crops are cultivated without the use of synthetic pesticides, herbicides, or chemical fertilizers, ensuring the absence of harmful chemical residues in the final product. This research paper examines the concept of organic farming with a focus on achieving residue-free production, assessing global trends, challenges, and strategies for success, with particular emphasis on India. The global organic farming area has expanded significantly, with organic farmland covering 72.3 million hectares in 2018, a 20% increase since 2013 (IFOAM, 2019). The organic food market, valued at $120 billion globally in 2018, reflects increasing consumer demand for products free from chemical residues. In India, the organic farming area grew from 1.2 million hectares in 2002 to 3.7 million hectares in 2018 (APEDA, 2018). This paper investigates key strategies for achieving residue-free organic production, including integrated pest management (IPM), crop rotation, the use of organic fertilizers, and other sustainable farming practices. Furthermore, it emphasizes the role of organic certification systems, regulatory oversight, and capacity building for farmers in ensuring compliance with residue-free standards. The study concludes that, while challenges persist, the future of organic farming with residue-free production is promising, with potential benefits for consumer health, environmental sustainability, and market growth. Ongoing innovation in farming practices, education, and regulatory frameworks will be essential to meet the growing demand for safe, chemical-free agricultural products.

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Soil to Sustenance: A Qualitative Approach into Agroecological Practices Linking Soil Health and Food Quality

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The intrinsic link between soil health and food quality is increasingly recognized as a cornerstone of sustainable agricultural systems. This study presents a qualitative assessment of the practices, perceptions, and outcomes associated with soil health management in diverse agroecological contexts. Drawing on in-depth interviews and focus groups with farmers, agronomists, and food producers across five countries, we explore how local knowledge, traditional practices, and innovative approaches converge to influence soil functionality and, ultimately, the nutritional and sensory quality of food.

Key themes emerging from the analysis include the role of organic amendments, crop diversity, minimal tillage, and integrated nutrient management in fostering resilient soil ecosystems. Participants consistently reported improvements in crop flavor, shelf-life, and nutrient density when prioritizing soil regeneration. Furthermore, the study highlights the socio-cultural and economic factors that shape adoption of soil-friendly practices, including access to resources, market incentives, and policy frameworks.

Our findings underscore the urgent need for transdisciplinary collaboration and context-specific solutions to rebuild soil health as a pathway to food systems that are both nourishing and sustainable. This research contributes to a growing body of evidence that qualitative, ground-level insights are essential for designing effective interventions at the nexus of soil and food.

Keywords: Soil health, food quality, agroecology, sustainable farming

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Regional Variability in Physico-Chemical Traits of Dalle Khursani (*Capsicum annuum var. cerasiforme*): A High-Altitude Chilli from the Eastern Himalayas

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Native to the Himalayan regions of Kalimpong, Darjeeling, and Sikkim, the red cherry pepper, also known as Dalle Khursani (Capsicum annum), is a highly valued chilli variety. This study aimed to characterize and investigate the physico-chemical properties of Dalle Khursani collected from various regions in order to understand its morphological, biochemical, and nutritional features. The following criteria were assessed in fresh samples collected from five distinct locations: Gangtok, Pakyong, Namchi, Darjeeling, and Kalimpong: size, weight, sphericity, bulk density, true density, porosity, hardness, moisture content, pH, fat content, ash content, vitamin C content, and color. The results revealed significant regional variations in physical attributes, with Namchi recording the largest fruit size and Pakyong the smallest. The sphericity of the samples ranged from 0.90 to 0.93, with Namchi showing the highest score. Its drying characteristics and shelf-life were influenced by the moisture content, which ranged from 81.75% (Pakyong) to 88.32% (Kalimpong). The pH readings ranged from 5.27 to 5.36, indicating mild acidity, while the fat content varied from 2.90% to 3.53%, with Kalimpong having the highest. The fact that Namchi had the highest vitamin C content (1166.67 mg/100g) and Kalimpong had the lowest (722.22 mg/100g) demonstrated its potential as a strong antioxidant source. Color analysis revealed minor regional variations in L, a*, and b* values*, highlighting pigmentation variances. Farmers, food processors, and researchers can use these findings to improve post-harvest management, processing techniques, and the development of value-added products. Its potential for usage in commercial spice production and nutraceutical applications is highlighted by Dalle Khursani's significant antioxidant content and distinct pungency. Further research on environmental tolerance and genetic variation could boost its yield and commercial worth.

Keywords: Dalle Khursani, High-Altitude Chilli, Characterization, Physico-Chemical Properties, Vitamin C.

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Leaf Curl Virus Diversity in Tomato and Papaya from Punjab: Molecular Identification and Phylogenetic Insights

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Leaf curl viruses pose a major threat to tomato and papaya production, causing severe leaf curling symptoms and substantial yield losses. In this study, naturally infected samples exhibiting typical curling symptoms were collected from tomato and papaya plants in the Punjab region. DNA was extracted, and partial coat protein (AV1) gene sequences were amplified and analyzed using Sanger sequencing.. The amplified products were sequenced, and phylogenetic analyses were carried out to determine evolutionary relationships. Results revealed the presence of *Tomato leaf curl Karnataka virus* isolate Punjab (GenBank accession **PX209273**) in tomato and *Tomato leaf curl Joydebpur virus* isolate Papaya_Punjab2023 (GenBank accession **PV953364**) in papaya. Phylogenetic analysis showed that these isolates clustered distinctly within their respective species clades, indicating the presence of multiple begomovirus strains in the region. These findings provide new insights into the molecular diversity and epidemiology of leaf curl viruses infecting solanaceous and non-solanaceous hosts in Punjab. The detection of diverse begomoviruses highlights the urgent need for effective management strategies and further studies on genetic variability, host adaptation, vector and pathogenicity to support sustainable crop production.

Keywords : Tomato leaf curl Karnataka virus; Tomato leaf curl Joydebpur virus; Begomovirus; Coat protein gene; Molecular characterization; Phylogenetic analysis

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New generation Hormone-Recombinant Gonadotropin (rGTH) for Previtellogenic Oocyte Progression in Captive Maturation of *Clarias magur*

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Clarias magur, an endangered and commercially important species in India, experienced reproductive hindrance, resulting in reduced viable fecundity due to a lack of progression in previtellogenesis. The administration of exogenous recombinant hormone, assisted with or without shower simulation, induced progression in the previtellogenesis stage of the treated females. It allowed the females to achieve final oocyte maturation. Applying the primary dose of 0.6ug $100g^{-1}$ and resolving dose of 0.4ug $100g^{-1}$ exogenous hormone with shower resulted in vitellogenesis and final oocyte maturation. The success rate of fish achieving maturation and final oocyte maturation was observed through the Ultrasonography method and Ovarian Biopsy, respectively. The treatment containing recombinant hormone with a shower resulted in 93% final oocyte maturation, whereas females treated with only the Hormone showed 86%. In contrast, the success rate observed in the shower only was 71%. The present finding elucidates that using exogenous hormones and shower simulation together increases the progression of the previtellogenic stage at a faster rate, which in turn overcomes the problems faced by Clarias magur under captivity and can be a valuable insight for carrying out seed production throughout the year.

Keywords: Recombinant Hormone, Shower, Clarias magur, Previtellogenic oocyte

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Perception of Food Labeling Among Allergic and Non-Allergic Consumers

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Labeling acts as an intermediary between producers and consumers. Consumers require correct and transparent labeling information to enable them to make informed choices. The government has introduced several regulations, such as the Food Safety and Standards Act of 2006, which requires labeling of all foods based on the Food Safety and Standards (Packaging and Labeling) Regulations of 2011. The FSSAI ensures that food labeling remains uniform and informative; however, consumers face several challenges. One of the most urgent concerns is the increasing number of diet-related public health problems. The objective of this study was to assess consumers' knowledge and awareness of food labeling information. A cross-sectional survey was conducted among 412 participants, 302 for non-allergic, 110 for allergic consumers, (through snowball sampling), to understand how consumers deal with the food labels. Data were analyzed by using mean ± standard deviation and ANOVA. Findings from this study indicate that allergic consumers are more aware of food labels, and respondents prefer social media and the Internet for information dissemination. Correct and transparent labeling information is required to enable them to make informed choices. Additionally, this study draws attention to the problems faced by allergic consumers and their sentiments about Indian food labels when buying food products in the market.

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Climate-Resilient and Sustainable Approaches for Fruit Production and Quality Improvement

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Climate change has emerged as a major challenge to fruit production, influencing yield, quality, and post-harvest behavior through its impact on temperature, rainfall, and biotic–abiotic stresses. Traditional fruit production systems often rely heavily on chemical inputs and conventional practices that reduce long-term sustainability. The adoption of climate-resilient strategies such as integrated nutrient management, efficient water use technologies, and the selection of stress-tolerant varieties has become crucial. These approaches not only safeguard productivity but also maintain soil fertility, biodiversity, and ecological balance, which are essential for sustainable horticulture.

Sustainable fruit production also emphasizes innovative orchard management practices such as high-density planting, canopy architecture optimization, mulching, fertigation, and protected cultivation. These methods enhance input-use efficiency, improve photosynthetic activity, and support better resilience against drought, heat, and irregular rainfall. The use of organic amendments, biofertilizers, and vermicompost further strengthens soil health while reducing dependency on synthetic chemicals.

Quality improvement in fruits under a sustainable framework involves the application of eco-friendly practices that enhance biochemical composition, flavor, and nutritional value. Integrating climate-smart and sustainable practices not only improves farmer income and market competitiveness but also contributes significantly to environmental conservation and food security. Hence, a holistic approach that combines modern technology with traditional knowledge holds immense potential to achieve climate-resilient and sustainable fruit production for the future.

Keywords: Climate-resilient, Sustainable, Precision horticulture, Canopy management and Climate-smart agriculture

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Impact Of Pleurotus Florida And Value Addition Trainings Among The Unemployed Youth Of Buldhana District, Maharashtra, India

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The cultivation of mushrooms has been recognized by scholars and agriculturists as a feasible and profitable farming activity, acting as a significant source of livelihood, job creation and rural progress. These initiatives aimed at employment generation and poverty amination play a vital role in enhancing the socio-economic condition of underprivileged communities, especially women in rural areas, numerous training sessions and workshops have been organized by various agricultural institutions. Women have exhibited a positive inclination towards mushroom farming. It has been observed that training in mushroom cultivation for constructive mindset, contributes to revenue generation, and offers financial assistance to households.

Keywords: medicinal mushrooms, traditional medicine, pest and disease.

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Reimagining School Food Environments: A Literature Review on Policy, Practice, and Adolescent Nutrition in LMICs

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The school food environment plays a pivotal role in shaping dietary behaviours during adolescence—a critical window for establishing lifelong health trajectories. In low- and middle-income countries (LMICs), rapid nutrition transitions, coupled with increasing exposure to ultra-processed foods, have intensified concerns around poor dietary quality among school-going adolescents. This literature review synthesizes global and regional evidence on the structural, policy, and behavioural dimensions of school food environments, with a focus on India and comparable LMIC contexts.

Drawing from peer-reviewed studies, policy analyses, and program evaluations published between 2010 and 2024, the review identifies four core thematic areas: (1) regulatory frameworks governing food availability and marketing in and around schools; (2) implementation fidelity and gaps in school-based nutrition programs; (3) socio-cultural and economic drivers influencing adolescent food choices; and (4) emerging models of participatory and context-sensitive interventions.

In India, flagship programs such as the Mid-Day Meal Scheme have improved food access but face challenges in dietary diversity, infrastructure, and monitoring. The review underscores the need for multi-sectoral strategies that align education, health, and urban planning policies to create enabling food environments.

This synthesis reveals a pressing gap in contextually grounded, adolescent-centred approaches to school food regulation. It advocates for policy innovations that go beyond nutrient-centric metrics to address food systems, equity, and agency. The findings aim to inform researchers, practitioners, and policymakers seeking to advance adolescent nutrition through sustainable and inclusive school food environments.

Keywords: School food environment, Adolescent nutrition, Low- and middle-income countries (LMICs), Nutrition transition, School-based nutrition programs, Policy and regulatory frameworks. Adolescent food choices

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Advancing Crop Improvement through Genome Editing: A targeted approach

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Genome editing is an exciting innovation in sustainable farming that uses tools like CRISPER-Cas9 to improve the crops. As the global population increases, food production needs to increase to meet demand. This technology allows precise changes to a plant's DNA, leading to benefits such as stronger plants that can withstand drought, pest resistance, provide better nutrition and higher yield. CRISPER-Cas9 has outperformed earlier gene editing methods like TALENS and ZFNs due to its exceptional efficiency, simplicity etc. The advantages of using genome editing in agriculture include the potential for higher food production, reduced reliance on harmful pesticides and fertilizers and improved adaptability to climate change. However, there are challenges to overcome, such as safety regulations and considering ethical issues related to genetic modification. Collaboration among researchers, policymakers and farmers will be essential to ensure that we harness the benefits of this technology while addressing any risks. As the field continues to advance, genome editing could be key to developing resilient farming system that effectively meet the increasing global demand for food.

Keywords – Genome editing, CRISPER-Cas9, sustainable farming, Safety regulations, ethical issues, food production.

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Biological and Molecular Characterization of Bacterial Gut Symbionts of Diamondback Moth, *Plutella xylostella* (L.)

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Third instar larvae of *Plutella xylostella* were accessed to feed on natural (Cabbage) and artificial diets with and without antibiotic, and were used for isolation of bacterial gut symbionts. Gut microbiota from *P. xylostella* reared on natural and artificial diets were identified based on morphological characteristics of bacterial colonies and their molecular characterization using 16S rRNA gene sequencing. A total of fourteen species of bacterial gut symbionts of distinctive characters were identified from larvae of Diamondback moth reared on natural and artificial diets with and without antibiotic. Larvae reared on natural and artificial diets without antibiotics harboured more bacterial gut symbionts than diets with antibiotics. The dominant bacterial gut symbiont phylum was Bacillota (Firmicutes) followed by Pseudomonadota (Proteobacteria). Bacterial gut symbionts from larvae reared on natural and artificial diet without antibiotic were high (13-14 species), while the gut microbiota diversity and species composition decreased with increasing concentration of antibiotic at 0.05%, 0.1% and 0.2% with 10, 8 and 5 bacterial gut symbionts, respectively. A similar trend was observed in artificial diets in which 9, 7 and 4 bacterial gut symbionts were identified at 0.05%, 0.1% and 0.2% concentrations of Streptomycin sulphate, respectively. Bacterial gut symbionts; *Stutzerimonas stutzeri*, *Staphylococcus aureus*, *Bacillus licheniformis* and *Pantoea agglomerans* were rapidly eliminated at all the three concentrations of Streptomycin sulphate, while *Enterococcus casseliflavus*, *Pseudomonas putida*, *Enterobacter absuriae* and *Carnobacterium maltaromaticum* bacteria were not eliminated even at 0.2% of Streptomycin sulphate.

Key words: *Plutella xylostella*, Streptomycin sulphate, Bacterial gut symbionts, 16S rRNA gene sequencing.

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Adoption and Application of ICTs for Enhancing Sustainable Farming Practices

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The present study was conducted in the state of Haryana to analyze adoption and application of information and communication technologies (ICTs) for enhancing sustainable farming practices. From this district, two blocks Hisar I and Hisar II were also selected randomly. Within each selected block, two villages were randomly chosen, and from each village, 30 respondents with small and marginal landholdings were purposefully selected. This study assessed the usability and utilization patterns of ICTs among 120 farmers to understand their role in enhancing decision-making across farming activities. This study explored how farmers use different ICT tools in their day-to-day agricultural activities, covering information seeking, production practices and marketing. The findings show that mobile phones and television are the most commonly used tools by farmers to stay informed about agriculture. When it comes to farming practices, farmers rely on ICTs to learn about seed selection, crop management, soil health, pest control and government support schemes. In addition, ICTs are used to access information beyond crop farming. Overall, the study highlights that ICTs play a vital role in making farming more efficient, informed and sustainable. However, their use is still concentrated around basic tools such as mobile phones, television and social media. Advanced ICT services like digital portals, specialized apps or online training are not yet fully utilized. To improve this situation, there is a need for capacity building, better digital literacy among farmers and stronger infrastructure support. Strengthening the adoption of ICTs will help farmers make better decisions, improve productivity and secure more stable livelihoods.

Keywords: ICT, mobile phone, social media, e-NAM, SMS services, agricultural information, government schemes, usability and utilization patterns

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Application of Tryptophan to Enhance Nutraceutical Quality of Brinjal

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Eggplant is a nutrient-dense vegetable low in calories and high in fiber. It provides vitamins, minerals and antioxidants, including anthocyanin, which give it a vibrant color. Tryptophan represents a powerful, nature derived biostimulant with multiple roles in promoting plant growth as well as enhancing stress tolerance. In the present experiment we have examined the various treatments of tryptophan for its effects on biochemical alterations associated with nutraceutical enhancement in two brinjal varieties, *viz.*, GAB 6 and GRB 8. Tryptophan priming and foliar application applied at various phenotypic stages. Tryptophan foliar application during the vegetative stage outperformed all other treatments in terms of biochemical characteristics in both cultivars. Overall anthocyanin, ascorbic acid, antioxidant activity, protein, soluble sugars content and enzyme activity found significantly higher as well anti nutrition glykoalkaloid found lower in GRB 8 as compared to GAB 6. The findings through biochemical analysis provide valuable insights into the potential of tryptophan to enhance the nutraceutical quality of eggplant. This research contributes to the ongoing efforts in agricultural science to optimize crop quality for enhanced nutritional and economic benefits.

Key words: Biostimulant, Eggplant, Nutraceutical quality, Tryptophan

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Morphological Trait Analysis in Tomato Germplasm: Exploring Essential Descriptors

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This study evaluates tomato germplasm lines acquired from ICAR-NBPGR, India, and various vegetable research stations, characterized under field conditions using a Randomized Block Design (RBD). Thirty genotypes were assessed based on ten qualitative traits, including leaf color, leaf pubescence, petiole pubescence, stem type, stem thickness, stem pigmentation, flower size, flower color, fruit size, and fruit shape. Significant variations among genotypes were observed, highlighting their unique morphological characteristics. These distinctive traits serve as valuable morphological markers for selection in segregating populations and for varietal identification in DUS (Distinctness, Uniformity, and Stability) testing. The findings suggest potential applications in breeding programs aimed at improving tomato cultivars through various breeding strategies. The unique combinations of these traits can significantly contribute to the development of superior tomato varieties with desirable horticultural characteristics.

Key words: ICAR-NBPGR, Breeding strategies, DUS testing, Morphological and Diversity

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Endophytic *Bacillus subtilis* as a source of antifungal genes and compounds for managing foliar diseases of tea in the Western Ghats, South India

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Tea (*Camellia sinensis*) is the second most consumed beverage globally. However, its cultivation is constrained by several pests and diseases, among which the foliar diseases—blister blight (*Exobasidium vexans*), grey blight (*Neopestalotiopsis clavispora*), brown blight (*Colletotrichum camelliae*), and twig dieback (*Fusarium asiaticum*) are predominant across the Western Ghats. These pathogens infect leaves and twigs, leading to significant yield and quality losses. Producing pesticide-residue-free tea at an affordable cost remains a major challenge for the tea industry. In this context, native biocontrol agents provide a sustainable alternative for disease management. An endophytic bacterium, *Bacillus subtilis*, isolated from tea leaves, showed strong antagonistic activity, inhibiting spore germination of *E. vexans* (93.39%), *N. clavispora* (86.27%), *C. camelliae* (64.07%), and *F. asiaticum* (82.6%) in vitro. Genomic analysis confirmed the presence of antifungal genes encoding iturin C & D, surfactin, bacilomycin A & D, bacilysin, fengycin, mycosubtilin, and β-glucanase. In addition, *B. subtilis* produced plant growth–promoting and antifungal compounds, including siderophores, cellulase, protease, amylase, and lipase. Non-volatile secondary metabolites from *B. subtilis* completely inhibited the growth of foliar pathogens, with GC–MS analysis identifying several bioactive compounds. Among them, 2,3,4-trihydroxychalcone exhibited the highest binding affinity towards key pathogenic proteins: cellulase, cutinase, and pectinase in *E. vexans*; β-tubulin, DNA-directed RNA polymerase, and melanin in *N. clavispora*; chitin synthase, cutinase, and pectate lyase in *C. camelliae*; and cutinase in *F. asiaticum*. These findings highlight the potential of endophytic *B. subtilis* as a promising biocontrol agent for the sustainable management of major foliar diseases of tea.

Key words: *Camellia sinensis, Bacillus subtilis,* Antifungal genes and Molecular docking

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Studies on the Different Amounts of Nitrogen and Organic Sources of Nutrient on Growth Parameters of Potato

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A research study titled **"Studies on the different amounts of nitrogen and organic sources of nutrient on growth parameters of potato"** was carried out at Research Farm, Department of Horticulture, MGCGV, Chitrakoot, Satna (M.P.) during 2016-17 & 2017-18.The details of materials used in experimental they have 20 treatments with control, the experiment analyzed (Pooled Basis) under Randomized Block Design (RBD), with three replications. The treatment details are T_1- Control, T_2- FYM 20 t ha^{-1}, T_3- Vermicompost 5 t ha^{-1}, T_4- Neem cake 2.5 q ha^{-1} T_5- 50 kg N ha^{-1}, T_6- 50 kg N ha^{-1}+ FYM 20 t ha^{-1}, T_7- 50 kg N ha^{-1}+ Vermicompost 5 t ha^{-1}, T_8- 50 kg N ha^{-1} + Neem cake 2.5 q ha^{-1}, T_9- 100 kg N ha^{-1}, T_{10}- 100 kg N ha^{-1}+ FYM 20 t ha^{-1}, T_{11}- 100 kg N ha^{-1}+Vermicompost 5 t ha^{-1}, T_{12}- 100 kg N ha^{-1}+ Neem cake 2.5 q ha^{-1}, T_{13}- 150 kg N ha^{-1}, T_{14}- 150 kg N ha^{-1}+ FYM 20 t ha^{-1}, T_{15}- 150 kg N ha^{-1}+Vermicompost 5 t ha^{-1}, T_{16}- 150 kg N ha^{-1}+ Neem cake 2.5 q ha^{-1}, T_{17}- 200 kg N ha^{-1}, T_{18}- 200 kg N ha^{-1}+ FYM 20 t ha^{-1}, T_{19}- 200 kg N ha^{-1}+Vermicompost 5 t ha^{-1} and T_{20}- 200 kg N ha^{-1}+ Neem cake 2.5 q ha^{-1}. The observation was recorded under the experiment (growth and yield) of potato such as Plant height (cm), Leaf length $plant^{-1}$ (cm) and Leaf area $plant^{-1}$ (cm^2). The result revealed that the maximum Plant height (cm) at 30, 60, and 90 DAS (37.39, 58.64 and 61.19 cm) was observed under N_4O_2 (200 kg N ha^{-1} + Vermicompost 5 t ha^{-1}), Leaf length $plant^{-1}$ (cm) at 30, 60, and 90 DAS i.e. (5.33, 8.15 and 8.99 cm) was observed under N_4O_1 (200 kg N ha^{-1}+ FYM 20 t ha^{-1}), Leaf area $plant^{-1}$ (cm^2) at 30, 60, and 90 DAS was observed under N_4O_2 (200 kg N ha^{-1}+Vermicompost 5 t ha^{-1}) i.e. (269.42, 532.26 and 612.44 cm^2), while the minimum was observed under Control.

Key Words: Potato, INM, FYM, NC and Vermicompost

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Recent Trends in Fruit and Vegetables Varieties

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Fruits and vegetables not only offer essential nutrients, vitamins, fiber, carbohydrates, and protein for sustaining healthy human life but also improve the GDP of many countries. Considering the extraordinary changes in the climate and the expected hidden conflicts, food and nutritional insecurity concerns of the world are mounting alarmingly high over the last few decades. These alarming circumstances demonstrate how a sizable portion of the world's population is "chronically undernourished" at the moment. Although food has been much more accessible since the green revolution, these foods are regrettably thought to be deficient in total nutritional value. Therefore, it is vitally important that the agricultural productivity of nutrient-enriched food crops be greatly increased within a few years or decades in order to address the issues of global food and nutritional insecurity.

For this the high yielding, improved as well as bio fortified varieties were released by Research Institutes, State Agricultural Universities as per the prerequisite by the farmers as well as consumer demand. These varieties are rich in nutrients, vitamins, fibre, carbohydrate, protein etc. However the demand for these fruits and vegetables is increasing day by day with increasing in the consumption habit, processing and export should be fulfil by using these new improved/hybrid/bio fortified varieties.

Key Word: Fruits, Vegetables, Varieties, Demand, Food security

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Formulation and Optimization of Functional Nutri Bar from Pseudo Cereals and functional seeds Using Response Surface Methodology

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The growing consumer demand for clean-label, nutrient-rich snack products have driven innovations in functional food development. Nutri-bars provide an excellent platform for delivering health benefits through indigenous plant-based ingredients, offering convenience and enhanced nutritional value. To develop and optimize a functional Nutri-bar enriched with buckwheat, green gram, chia seeds, and pumpkin seeds by varying natural binders (ghee, jaggery, water) using statistical modeling for improved sensory, textural, and nutritional properties. A D-optimal design integrated with Response Surface Methodology (RSM) was employed to evaluate the effect of ghee (3–7%), jaggery (20–40 g), and water (70–90 ml) on key quality attributes. Fifteen experimental formulations were prepared and analyzed for sensory acceptability, texture (hardness, fracturability), and proximate composition under standardized baking conditions (160 °C for 45 min). Regression modeling and ANOVA were applied to identify significant factors ($p < 0.05$) and model adequacy. The developed regression models showed high predictive accuracy ($R2 > 0.90$), confirming the significant impact of binder interactions on sensory and textural attributes. Three optimized formulations (S14, S5, and S10) achieved superior protein content (15.6–15.8%), desirable textural integrity, and higher sensory scores (>6.8 on a 9-point hedonic scale). These formulations complied with FSSAI standards for nutritional bars. The study demonstrates the effectiveness of RSM and D-optimal design in functional food development. The optimized Nutri-bar formulation successfully integrates natural binders and indigenous ingredients, delivering a nutrient-dense, sensory-acceptable snack product with strong potential for commercial scalability and consumer acceptance.

Keywords: Functional Nutri-bar, Pseudo Cereals, Natural binders, Response Surface Methodology, D-optimal design, Sensory evaluation

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Artificial Intelligence (AI) in agriculture

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The integration of Artificial Intelligence (AI) into agriculture represents a transformative shift, moving the industry from traditional practices to data-driven, efficient, and sustainable methods. AI technologies including machine learning, computer vision, natural language processing, and robotics are being deployed across the agricultural value chain to boost productivity, optimize resource use, and tackle global challenges such as food insecurity and climate change. Through precision agriculture, AI enables real-time monitoring and management of crops, soil, and environmental conditions using data from sensors, drones, and satellite imagery. Machine learning algorithms process this data to generate actionable insights on optimal planting times, irrigation schedules, fertilizer usage, and pest or disease control. Predictive models powered by AI also assist in yield forecasting, risk evaluation, and market trend analysis, supporting more informed decision-making for farmers and agribusinesses alike. Despite its transformative potential, the widespread adoption of AI in agriculture faces several challenges. These include high initial investment costs, limited digital infrastructure in rural areas, data privacy concerns, and the need for adequate training and support for farmers to effectively use AI tools. In conclusion, AI offers a powerful toolkit for revolutionizing agriculture by making it more intelligent, responsive, and sustainable. As global agricultural demands continue to rise, the integration of AI will be instrumental in building resilient food systems capable of feeding a growing population while preserving natural resources.

Keywords: Agriculture, Machine learning, Artificial intelligence, Robotics, Precision Agriculture, Resource optimization.

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Nutritional Efficacy of Moringa *Oleifera* Leaf Powder in Improving Haemoglobin Status and Reducing Malnutrition among Tribal Adolescent Girls of Harda District (M.P.)

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Malnutrition remains a major public health challenge among tribal adolescent girls in India, particularly in resource-constrained regions such as Harda district of Madhya Pradesh. Micronutrient deficiencies, especially anemia, adversely affect growth, development, and overall well-being during adolescence. This study was undertaken to evaluate the efficacy of Moringa *Oleifera* Leaf Powder as a nutritional supplement in improving haemoglobin levels and perceived energy status among tribal adolescent girls.

A community-based intervention was conducted among 30 tribal adolescent girls aged 13-15 years in Harda village. Each participant received a daily supplement of Moringa *Oleifera* Leaf Powder 10g/day, incorporated into their diet for a period of 3 months. Haemoglobin levels were assessed pre-and post intervention, and qualitative feedback regarding energy levels and well-being was collected.

The results demonstrated a marked improvement in mean haemoglobin concentration, rising from 10.2 g/dl at baseline to 11.9 g/dl post-intervention, indicating significant reduction in anaemia prevalence. Furthermore, participants also reported enhanced energy levels, reduced fatigue, and a greater sense of activeness in daily activities.

The findings highlight the potential of Moringa *Oleifera* leaf powder as an affordable, culturally acceptable, and sustainable dietary intervention to combat malnutrition and anemia among tribal adolescent girls. Scaling up such interventions through community nutrition programmes and integration into government schemes could play a pivotal role in improving adolescent health outcomes in tribal regions.

Keywords: Moringa *Oleifera*, Malnutrition, Anaemia, Adolescent girls,Tribal Communities, Haemoglobin.

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Impact of Pro-Super Bags in Enhancing Food Grain Storage and Grain Quality in Kolipura Village of Harda District (M.P.)

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The safe storage of food grains is a critical challenge in rural areas, where conventional storage methods often result in significant quantitative and qualitative losses. A field study was conducted in Kolipura village of Harda district, Madhya Pradesh during September, 2023 to evaluate the impact of Pro-Super Bags on the storage quality of wheat for a period of Six months. The study compared Pro-Super Bags with traditional gunny bags as storage types.

The findings revealed that wheat stored in gunny bags experienced a weight loss of 2.78% (from 100 kg to 97.22 kg) over Six months, accompanied by visible pest infestation and deterioration in grain quality, leading to unsatisfactory overall feedback. In contrast, Wheat stored in Pro-Super Bags showed only 0.58% weight loss (from 100 kg to 99.42 kg), with no pest or damage observed and maintenance of good grain quality, resulting in very satisfactory overall feedback. These results highlight the superior efficacy of Pro-Super Bags in minimizing storage losses, preserving grain quality, and ensuring food security in rural communities. Adoption of Pro-Super Bags can therefore play a significant role in reducing post-harvest losses, improving household food availability, and enhancing farmers' income in tribal and rural regions of Madhya Pradesh.

Keywords: Pro-Super Bags, Wheat Storage, Post-harvest losses, Grain Quality, Food Security

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Natural & Organic farming for sustainability in paddy cultivation

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In view of excess use of chemical based fertilizers, the soil organic carbon content and potential microorganisms required for soil fertility are being depleted, it is the time to shift to natural and organic based farming. So, an on farm trail was conducted in three locations of farmers field where in natural farming practices (Seed treatment with Beejamrutham,100 kg FYM + 100 kg ghanajeevamrutham per acre, Jeevamrutham @ 200 L/acre as spray covering both soil and crop or soil application as drenching from 15 DAS till 15 days before harvesting, which ever is feasible at 15 days interval, manual weeding, organic farming practices (Nutrient package: Green manure with Dhiancha @ 15 kg per acre and *in situ* incorporation at 50% flowering, FYM@ 4 t/acre, *Azospirillum*, PSB and KRB @ 2 kg/acre each along with 100 kg FYM at the time of planting, neem cake@ 200kg/acre or vermicompost @ 500 kg /acre at tillering and PI stage. Pest management practices: Application of Pseudomonas fluorescence spray @10g/lit, Azardirectin 1500 ppm at nursery and 10 and 25 DAT @ 5 ml/L, Trichogramma japonicum (Trichocards) @ 40,000/acre/release, erection of bird perches @20 per acre, installation of pheromone traps @ 8 per acre, formation of alleyways, alternate wetting and drying and NSKE (neem seed kernel extract 1500 ppm) were evaluated against farmers practices in paddy. The results inferred that the biometric observations like plant height (98 cm, 96 cm), No of panicles per hill (16, 17) No of grains per panicles (282, 294), Grain yield (5326, 5416 Kg ha^{-1}) were found to less in natural and organic farming practices. Even though grain yields were reduced in natural farming (5326 kg ha^{-1}) and organic farming practice (5416 Kg ha^{-1}) , net returns were increased due to low cost of cultivation in natural and organic farming. The corresponding values of weed density, stem borer, leaf folder and sheath blight incidence in farmers practice was found to be 22 %, 28 %, 20 % and 12 % respectively. The yield and cost benefit ratio with respect to natural farming, organic farming and farmers practice was 5326 Kg ha^{-1} & 2.23:1, 5416 Kg ha^{-1} & 2.15:1 and 5850 Kg ha^{-1} & 1.98 : 1 respectively. Hence in paddy natural farming practices, organic farming practices are to be promoted in order to have a non residual and improve soil fertility.

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Analysis of growth rate of rice crop in different districts of Chhattisgarh state

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The present study was conducted with a view to analyze growth rate of rice crop in different districts of Chhattisgarh. For the purpose of studying secondary data of area, production and productivity of rice crop in different districts of Chhattisgarh state was downloaded from the Directorate of Economics and Statistic, Department of Agriculture Ministry and Farmer Welfare, Govt. of India. The study was conducted for a period of 23 years (2000-2023). As new districts were formed in 2011 from older districts. So, we bifurcate 23 years into two decades from 2000-2010 and 2011-2023. The compound growth rate (CGR) and Simple growth rate (SGR) were analyzed for rice crops for the same period. In the study significant variations in the growth rate among different districts were observed. Rice showed increasing productivity in most of the districts, while area and production exhibited either increasing and decreasing growth rate. Bemetara district showed a highly significant growth rate for area, production and productivity of rice crop. On comparison between before and after bifurcation of districts. The result also depicted that Bastar and Rajnandgaon were found to significantly increase the growth rate for productivity of rice.

Key words: Rice, compound growth rate, simple growth rate, area, production, productivity.

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Quantitative Determination of Proteins and Carbohydrates in *Artemisia absinthium* and *Acorus calamus* from Different Locations of Kashmir

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The present study was conducted to evaluate and compare the macronutrient composition, specifically protein and carbohydrate content, of *Artemisia absinthium* and *Acorus calamus* collected from the northern and southern regions of the Kashmir Valley. Plant samples were shade-dried, powdered, and subjected to proximate analysis using standard AOAC methods. Results revealed that *Artemisia absinthium* possessed a substantially higher protein content (18.5%) compared to *Acorus calamus* (11.5%), indicating its potential as a superior plant-based protein source. Similarly, carbohydrate analysis demonstrated higher values in *Artemisia absinthium* (39%) relative to *Acorus calamus* (35%) of dry weight, suggesting greater energy-yielding potential. The observed nutritional superiority of *Artemisia absinthium* may be attributed to its adaptive physiological traits in the temperate climatic conditions of Kashmir, leading to enhanced biosynthesis and accumulation of primary metabolites. These findings highlight *Artemisia absinthium* as a promising candidate for incorporation into nutraceutical formulations and functional foods aimed at addressing dietary protein and carbohydrate requirements. Furthermore, the comparative data on *Acorus calamus* enrich the existing nutritional profile of this traditionally valued medicinal plant, supporting its role in herbal dietary preparations. The study provides a scientific basis for valorizing these plants in food and pharmaceutical applications, thereby contributing to the sustainable utilization of the region's botanical resources.

Keywords: *Artemisia absinthium, Acorus calamus, Protein, Carbohydrate, Kashmir, Medicinal plants.*

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Importance of Pulses in Organic Farming: A Review

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Organic farming is gaining global attention due to its emphasis on sustainability, environmental health, and food safety. As leguminous crops, pulses play a vital role in organic farming systems due to their ability to fix atmospheric nitrogen, enhance soil fertility, and support biodiversity without the need for synthetic inputs. This review outlines the multifaceted importance of pulses in organic agriculture, highlighting their agronomic, ecological, economic, and nutritional benefits. It examines their contribution to soil health, crop productivity, pest management, and nutrient cycling. It also discusses the challenges and prospects of integrating pulses in organic systems, supported by research findings. The review highlights the crucial role of pulses in promoting sustainable and resilient organic farming systems.

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Evaluating the efficacy of Bio-enzymes in Marigold Cultivation

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Bio-enzymes can be promoted as eco-friendly alternatives to chemical fertilizers by utilizing organic waste such as fruit peels and vegetable scraps to reduce landfill waste and minimize reliance on synthetic chemicals. This research entitled "Evaluating the efficacy of Bio-enzymes in marigold cultivation" was carried out to see different composition of bio-enzymes and effects of different bio-enzymes on growth of African marigold var. Pusa Narangi Gainda. The experiment was laid out in Completely Randomized Design along with 3 replications and 6 treatments *viz*. (T1) Control, (T2) Citrus bio-enzyme @ 2%, (T3) Banana bio-enzyme @ 2%, (T4) Vegetable bio-enzyme @ 2%, (T5) Panchgavya bio-stimulant @ 2%, and (T6) Jeevamrut bio-stimulant @ 2%. Among all the treatments, T4 shows the highest plant height after 60 DAS i.e. 28.72cm. At 60 DAS, T4 shows the maximum plant spread (NS-EW) i.e. 22.04cm-19.94cm and takes the least number of days for flower bud emergence, 50% of flowering and full flowering. T4 also gives the highest number of flowers per plant and maximum fresh (5.35g) and dry (0.51g) flower weight. Total carotenoid content present in flowers of T6 (13.37µg/ml) is found to be highest compared to other treatments in which T4 (10.2µg/ml) comes second highest. In overall conclusion, T4 i.e. vegetable bio-enzyme @ 2% and other bio-enzymes give the most beneficial result on vegetative growth and flower parameters of Marigold as compared to other bio-stimulants and control.

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Constraints Faced By Women Dairy Farmers In Adopting Scientific Management Practices: A Study In Yavatmal District, Maharashtra

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Dairy farming in the Yavatmal district of Maharashtra, India, is a crucial agricultural activity with significant growth potential. However, women dairy farmers in the region face a unique set of interconnected constraints that limit their ability to adopt modern and scientific dairy management practices. This study aimed to identify and rank the most significant constraints faced by women dairy farmers in the Yavatmal district. A total of 200 respondents were purposively selected from five villages in the Darwha Block and interviewed using a well-structured and pre-tested interview schedule. The collected data were tabulated and analyzed using simple statistical methods. The results revealed that economic pressures and high costs were the most impactful challenges, with low milk prices (86.5%), high concentrate prices (84%), and high charges by private practitioners (68%) being the top three constraints. Mid-tier constraints included breeding and feed challenges, such as the non-availability of specific breed semen (61.5%) and green and dry fodder (60.5%). Operational efficiency issues, such as a shortage of skilled milking personnel (51.5%) and poor availability of concentrates and mineral mixtures (49%), were also identified. Infrastructure, labor, and extension gaps were among the bottom-tier constraints of the study. These findings highlight the need for targeted interventions and support systems to empower dairy farm women and enhance the adoption of scientific dairy management practices in the Yavatmal district, ultimately leading to improved productivity, efficiency, and overall sustainability in the dairy farming industry.

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Comparision Among Different Collection Methods Of Mymaridae (Hymenoptera) Parasitoid

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The Mymaridae, commonly known as fairy flies, are among the smallest parasitoid wasps, playing a crucial role in biological control by parasitizing insect eggs. Despite their ecological importance, their minute size and cryptic habitats pose challenges for effective field collection and biodiversity assessment. This study compares the efficiency of three commonly used insect sampling methods—Yellow Pan Trap (YPT), Malaise Trap (MT), and Sweep Net (SN)—for collecting Mymaridae across two agroclimatic zones of West Bengal, India. YPT exhibited the highest mean capture rate at 1.974 individuals per 15 days, significantly outperforming both MT (0.256) and SN (0.218). We have 12 genera of Mymarids in YPT, 9 in MT and 8 in SN. Our results indicate that YPTs are significantly more effective in capturing a broader diversity and higher abundance of Mymaridae genera compared to MT and SN. The superior performance of YPTs is likely due to their visual attraction to phototactic insects like Mymarids. MTs and SNs showed overlapping but comparatively lower capture rates, suggesting their limited efficiency in sampling this group. These findings align with previous studies and highlight the importance of selecting appropriate collection techniques when assessing parasitoid wasp diversity. While YPTs are recommended as the most effective standalone method, incorporating multiple collection techniques may offer a more comprehensive understanding of Mymaridae diversity and distribution, particularly for ecological monitoring and integrated pest management programs.

Keywords: Yellow pan trap, Malaise trap, Sweep net, Mymaridae, New alluvial zone, Coastal saline zone.

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Targeted Gene Editing with CRISPR-Cas9 to Enhance Disease Resistance and Growth Traits in Rainbow Trout for Sustainable Aquaculture in the Western Himalayan Biodiversity Hotspot of India

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Rainbow trout (*Oncorhynchus mykiss*) is a key species in cold-water aquaculture; however, its production is often limited by disease outbreaks and suboptimal growth, which adversely affect both yield and long-term sustainability. This review discusses the potential applications of CRISPR-Cas9 in rainbow trout aquaculture, focusing on molecular targets, gene-editing methodologies, and associated challenges. CRISPR-Cas9 enables site-specific gene modification by inducing double-stranded breaks at target loci, which are repaired through non-homologous end joining (NHEJ) or homology-directed repair (HDR). Candidate genes such as *tlr5* and *il-1β*, which regulate pathogen recognition and inflammatory responses, represent promising targets for enhancing disease resilience. Experimental strategies include microinjection of CRISPR ribonucleoproteins into one-cell stage zygotes and electroporation of early embryos, with validation performed using PCR and next-generation sequencing. Emerging studies from related species highlight the feasibility and precision of such approaches. The application of genome editing technologies is significant in Kashmir Valley, where cold-water fisheries form an integral part of local economies, food security, and cultural heritage. Sustainable improvement of disease resistance and growth traits in rainbow trout can reduce production losses, promote resilient aquaculture practices, and alleviate pressure on wild fish populations. This underscores the critical role of responsible biotechnology adoption to ensure that aquaculture development aligns with long-term ecosystem health in the Kashmir Valley and the broader Himalayan region.

Keywords- CRISPR-Cas9, Rainbow trout, Genome editing, Disease resistance**,** Growth enhancement, *tlr5*, *il-1β*, *ghr*, *igf*..

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Biomass Accumulation and Carbon Storage Potential of *Gmelina arborea* in Sloping Land Agroforestry Systems

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Biomass plays a pivotal role in mitigating climate change while enhancing ecosystem sustainability in fragile hill slope regions. *Gmelina arborea*, a fast-growing, multipurpose tree species, has emerged as a suitable component in agroforestry systems due to its high biomass productivity, adaptability, and soil-restoring capacity. The present study examines biomass accumulation and carbon sequestration potential of *G. arborea* grown on hill slope-based agroforestry systems. Results indicate substantial above-ground biomass production, with significant carbon storage. Integration of *G. arborea* with agricultural crops not only improves soil fertility and reduces erosion on sloping lands but also contributes to long-term carbon sinks, thereby offering a dual advantage of livelihood security and environmental sustainability. The findings highlight that adoption of *G. arborea*-based agroforestry in hill ecosystems can serve as a climate-resilient land-use strategy, enhancing carbon sequestration, microclimatic moderation, and sustainable resource utilization.

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Climate Change and Crop Yield Simulations for Haryana: Evidence from Agro-Economic Models

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This study assesses the economic consequences of climate change for Haryana, India, one of the country's most intensive agricultural states and increasingly exposed to climatic stress. Primary data were collected from 400 farm households across 40 villages in eight climatically vulnerable districts. An integrated framework was employed, coupling the DSSAT crop models for wheat (HD-2967) and rice (PR-126) with econometric approaches including a fixed-effects panel regression and a Ricardian cross-sectional model. Future climate conditions were derived from five CMIP6 global circulation models under SSP2-4.5 and SSP5-8.5 scenarios, bias-corrected against observed data. Results demonstrate a strong non-linear response of crop yields to temperature increases. By mid-century, wheat yields are projected to decline by 11.4 percent (±3.2) under SSP2-4.5 and by 17.2 percent (±4.5) under SSP5-8.5, while rice yields decline by 8.7 percent (±4.1) and 12.8 percent (±5.3), respectively. These yield shocks correspond to annual economic losses of ₹3,200–5,800 crore by 2050, with pronounced district-level disparities: arid western districts such as Hisar and Sirsa are more severely affected than relatively better-watered eastern districts, including Karnal and Kurukshetra. Adaptation strategies modeled within DSSAT indicate that advancing sowing dates and adopting heat-tolerant cultivars can offset 40–60 percent of projected yield losses and help stabilize farm incomes. However, these measures raise irrigation requirements by 10–18 percent, highlighting a fundamental trade-off between climate adaptation and water sustainability. The findings underscore the urgency of district-specific, climate-resilient agricultural policies that promote both productivity and groundwater conservation in Haryana.

Keywords: Climate Change, Crop Simulation, Economic Impact, Adaptation Strategies, DSSAT, Ricardian Model, Haryana, Wheat, Rice.

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Assessment of Soil Erosion and Sediment Yield through GIS-Based Modeling Approaches: A Case Study of Dhansiri River Basin

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Soil erosion and sediment yield provide significant environmental concerns in river basins, leading to land degradation, diminished soil fertility, and increased siltation of reservoirs. The Dhansiri River Basin in Northeast India is especially susceptible owing to its humid monsoonal climate, delicate geomorphology, and swiftly evolving land-use practices. This study evaluated soil erosion and sediment yield using GIS applications of the Universal Soil Loss Equation (USLE), the Revised Universal Soil Loss Equation (RUSLE), and the Modified Universal Soil Loss Equation (MUSLE). Model factors, such as rainfall erosivity (R), soil erodibility (K), slope length and steepness (LS), cover-management (C), and conservation practice (P), were obtained from rainfall data (2010-2023), soil maps, a 30 m resolution Digital Elevation Model (DEM), and land use/land cover (LULC) information.The spatial study reveals that the Dhansiri Basin undergoes an average yearly soil loss of roughly 18.6 t/ha/yr, with measurements varying from less than 5 t/ha/yr in densely forested areas to exceeding 50 t/ha/yr in steep agricultural and barren slopes. The MUSLE model projected an annual sediment yield of 1.27×10^7 t/yr, with sub-watershed contributions ranging from 0.5 to 2.3×10^6 t/yr, highlighting unequal sediment export from erosion-prone locations.The spatial research shows that 18.6 t/ha/yr of soil is lost in the Dhansiri Basin, ranging from less than 5 t/ha/yr in thickly forested areas to over 50 t/ha/yr in steep agricultural and barren slopes. Upper catchments with steep gradients and significant precipitation had 22% of the basin's high-risk erosion zones. MUSLE software calculated annual sediment yield at 1.27×10^7 t/yr, with sub-watershed contributions ranging from 0.5 to 2.3×10^6 t/yr, indicating unequal sediment export from erosion-prone locations.

Keywords: - Soil Erosion,USLE, RUSLE, MUSLE, Dhansiri River Basin

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Effect of Nitrogen Dynamics on Growth, Yield, and Quality of Sorghum (Sorghum bicolor L.)

Tarachand Prajapati* O.P. Sharma**

The present investigation entitled *"Influence of Nitrogen Management on Yield and Quality of Sorghum (Sorghum bicolor L.)"* was conducted during the Kharif season of 2024– 2025 at the Agricultural Research Farm, School of Agriculture, Suresh Gyan Vihar University, Jaipur, Rajasthan. The experiment was laid out in a split-plot design with five nitrogen management practices and three biofertilizer inoculations using sorghum variety CSV-15. The nitrogen treatments included: N1 (100 kg N/ha through urea), N2 (75 kg N through urea + 25 kg N/ha through castor cake), N3 (75 kg N through urea + 25 kg N/ha through FYM), N4 (50 kg N through urea + 50 kg N/ha through castor cake), and N5 (50 kg N through urea + 50 kg N/ha through FYM). Biofertilizer treatments comprised B1 (no inoculation), B2 (*Azotobacter*), and B3 (*Azospirillum*). The results revealed that while plant stands remained unaffected, growth parameters such as plant height, leaf area index, number of leaves, dry matter accumulation, chlorophyll content, and tillering were significantly influenced. The treatments N3 and B3 consistently produced superior results.

Yield attributes and yield were also significantly improved. N3 and B3 produced the highest grain number per ear head (1223 and 1355, respectively), panicle weight (71.93 and 72.60 g), and 1000-grain weight (25.08 and 26.14 g). The maximum grain yield (3752 kg/ha), straw yield (6542 kg/ha), and biological yield (10294 kg/ha) were obtained with N3 + B3, whereas N1 + B1 recorded the lowest. Protein content was maximized at 7.75% with N3 and 8.22% with B3. Economic analysis showed that N3 and B3 treatments gave the highest returns, with the combination N3 + B3 achieving a maximum gross return of ₹179993 ha^{-1} and net return of ₹136156 ha^{-1}. The highest benefit– cost ratio (3.42) was recorded under N1 + B3, while the lowest was in N4 + B1 (1.28). Overall, the study concludes that the integrated application of urea, organic nitrogen (castor cake or FYM), and biofertilizer (*Azospirillum*) significantly enhances sorghum growth, yield, nutrient use efficiency, and profitability. This integrated approach offers a sustainable and productive strategy for sorghum cultivation in semi-arid regions of Rajasthan.

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Response of Mungbean (*Vigna radiata* L.) to Weed Control Practices in Rajasthan

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An investigation "Response of Mungbean (*Vigna radiata* L.) to Weed Control Practices in Rajasthan" was carried out during the *kharif* season of 2024 at the Research Farm, Suresh Gyan Vihar University, Jaipur, on loamy sand soil. The experiment finding recorded that application of pendimethalin 0.75 kg/ha PE fb Imazethapyr 40 g/ha 20 DAS significantly lowest the density and dry matter of weeds at 30 DAS and harvest. Whereas maximum weed control efficiency was recorded with pendimethalin 0.75 kg/ha PE fb Imazethapyr 40 g/ha 20 DAS. Pendimethalin 0.75 kg/ha PE fb Imazethapyr 40 g/ha 20 DAS was significantly enhanced the number of pods per plant, number of seeds per pods, seed, straw and biological yield of green gram as compared to weedy check, Propaquizafop + imazethapyr PoE @ 100 g a.i./ha, Clodinafop-propargyl + sodium-acifluorfen PoE @ 187.5 g a.i./ha, Imazethapyr 40 g/ha 20 DAS and remained statistically at par with weed free.

Key words: Imazethapyr, Pendimethalin, Pod, Seed and Yield

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Black Ginger (*Kaempferia parviflora*): Emerging Opportunities in Health, Nutrition, and Sustainable Horticulture

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Black ginger (*Kaempferia parviflora*), is an underutilized but highly valuable medicinal and functional crop belonging to the Zingiberaceae family. Indigenous to Southeast Asia, this plant has long been integrated into folk medicine for enhancing vitality, stamina, and overall well-being. In recent decades, scientific interest has accelerated owing to its rich profile of polymethoxyflavones and other bioactive constituents that demonstrate diverse pharmacological activities including antioxidant, anti-inflammatory, antidiabetic, neuroprotective, and cardioprotective effects. Clinical and preclinical studies further support its role in regulating lipid metabolism, improving blood circulation, and mitigating age-related disorders, making it a strong candidate for nutraceutical and pharmaceutical applications. From an agronomic perspective, black ginger has significant potential as a high-value horticultural crop due to its adaptability to tropical and subtropical climates, relatively low input requirements, and expanding export markets. The crop's inclusion in diversified farming systems can contribute to income generation, crop resilience, and sustainable land use. Advancements in propagation techniques, organic cultivation practices, and post-harvest processing are creating new avenues for scaling up production. Moreover, protected cultivation, tissue culture, and precision farming technologies can further enhance both yield and quality. This abstract explores the nutritional, medicinal, and economic significance of black ginger, emphasizing its scope in nutraceutical and pharmaceutical industries, while addressing challenges in standardization, sustainable cultivation, and market development. The discussion aims to provide insights into positioning black ginger as a crop of the future for both health and livelihood security.

Keywords: Medicinal, livelihood security, nutraceutical and pharmaceutical.

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Climate change impact and adaptation strategies in wheat under semi arid conditions

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As per IPCC's Sixth Assessment Report, global mean air temperature has increased by 1.1^0 C and is projected to increase by 1.5 to 6.4 ^{0}C by 2030 and 2052 (IPCC, 2021-2023). An increasing trend in surface temperature in India is observed during last century (Rupa Kumar *et al.*, 2006). Due to climate change, mean temperatures and the frequency of temperature fluctuations will increase resulting in cold waves or heat waves and significant loss to crop production in India.. Cereal requirement of India by 2030 is projected to be 272.1 to 273.3 million tones according to NABARD (2023). Due to increasing food demand and challenges from climate change, there is a need to assess the impact of climate change on crop production and derive adaptation strategies to cope up these losses to feed the growing population. Wheat is grown all over the world for its wider adaptability and high nutritive value. It contributes about 38% of the total food grain production in India. In Rajasthan, it covers approximately 3.31 million hectares, with 9.82 million tonnes total production and a productivity of 2.96 t/ha (Anon., 2023-24). Wheat being sensitive to high temperatures, a simulation analysis was carried out at Jaipur to quantify the impact of increased temperatures (1, 2, 3, 4 and 5 ^{o}C) and elevated CO_2 (369, 450, 550 and 650ppm) alone and in combination on wheat yield using InfoCrop model. Results revealed that elevated CO_2 alone increased the wheat yields. Increase in temperature by 1^{o}C (369 ppm CO_2 concentration) reduced wheat yield by 6.8 to 9.5 %. Decreasing trend in yield was observed with 1, 2, 3, 4 and 5 ^{o}C increase in temperature. The combined impact of increased temperature and elevated CO_2 resulted in net decline in yield in spite of CO_2 fertilization. However, adaptation strategies such as adjusting sowing dates and optimizing water and nutrient management helped to mitigate these adverse impacts of climate change on wheat yields.

Key words: Wheat, Simulation, Temperature, CO_2, Adaptation strategies

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Strengthening the Baby-Friendly Hospital Initiative in India: A Review of Policies, Gaps, and Strategic Directions

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Breastfeeding is a proven, cost-effective public health intervention with profound benefits for neonatal survival, maternal health, and long-term child development. To strengthen breastfeeding practices in health facilities, the World Health Organization (WHO) and UNICEF launched the Baby-Friendly Hospital Initiative (BFHI) in 1991, providing a global framework through the Ten Steps to Successful Breastfeeding. Global evidence demonstrates its effectiveness in improving early initiation of breastfeeding, exclusive breastfeeding rates, and maternal satisfaction. However, implementation and sustainability remain uneven due to gaps in staff capacity, weak institutional accountability, and insufficient integration into national health systems.

In India, BFHI was introduced in the early 1990s and later embedded within broader policy frameworks, including the National Guidelines on Infant and Young Child Feeding and the MAA (Mother's Absolute Affection). Nationally, exclusive breastfeeding stands at 63.7%, with Telangana slightly lower at 60.3% (NFHS-5, 2019–21). While government programs such as LaQshya (Labour Room Quality Improvement), indirectly align with BFHI principles, the lack of systematic certification, periodic assessments, and sustained training has limited institutionalization.

This review synthesizes global and national evidence on BFHI implementation, identifies systemic gaps that hinder sustainability, and examines enablers that have supported successful adoption in comparable contexts.

The review proposes a strategic framework tailored for urban hospital settings. The expected outcome is a set of actionable, evidence-informed recommendations that can guide policymakers, healthcare administrators, and practitioners in strengthening breastfeeding-supportive environments, institutionalizing BFHI practices, and ultimately improving neonatal and maternal health outcomes in India.

Key Words: BFHI, Baby Friendly Hospital Initiative, Maternal, IYCF, MAA

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Sustainable Agriculture: Environmental Health

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In simplest phrases, sustainable agriculture is the manufacturing of meals, fiber, or exceptional plant or animal merchandise using farming techniques that protect the environment, public health, human groups, and animal welfare. The phrase sustainable has grown to be very popular in recent years and it's far now used to explain loads of things. Sustainable agriculture is a kind of agriculture that specializes in generating long-term plants and cattle at the same time as having minimum outcomes on the surroundings. This kind of agriculture tries to discover a top balance among the want for food production and the preservation of the ecological gadget inside the environment. In addition to generating meals, there are several general goals associated with sustainable agriculture, consisting of holding water, reducing the use of fertilizers and pesticides, and selling biodiversity in plants grown and the ecosystem. Sustainable agriculture additionally specializes in retaining monetary balance of farms and assisting farmers improve their techniques and satisfactory of existence.

Environmental sustainability and sustainable development are one in the equal; there are quite some approaches wherein they diverge in their goals. They do have the identical standard aim of retaining herbal resources and creating extra energy efficient initiatives and practices. The goal of environmental sustainability is to preserve natural resources and to develop and exchange resources of strength while lowering pollution and harm to the environment. The various initiatives that are rooted in environmental sustainability will involve replanting forests, keeping wetlands and protective natural regions from resource harvesting.

Key Words: Sustainable, Environment, Agriculture, Plant and Animal.

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HPLC Characterization and In Vitro Antifungal Efficacy of Moringa and Ylang Ylang Essential Oils Against *Bipolaris maydis*: Insights from Molecular Docking

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Maize (*Zea mays* L.) is a vital crop for global food security, yet its productivity is severely threatened by fungal diseases, particularly southern corn leaf blight caused by *Bipolaris maydis*. Reliance on synthetic fungicides for disease management poses environmental and health concerns, underscoring the need for sustainable alternatives. This study evaluates the antifungal efficacy of Moringa (*Moringa oleifera*) and Ylang Ylang (*Cananga odorata*) essential oils against *B. maydis* under in vitro conditions. Antifungal activity was assessed using the poisoned food technique, where both oils significantly inhibited mycelial growth in a dose-dependent manner. Ylang Ylang oil demonstrated higher efficacy, achieving complete inhibition at lower concentrations compared to Moringa oil. High-performance liquid chromatography (HPLC) analysis revealed phenolic and volatile compounds as major constituents, supporting their antifungal potential. These biochemical insights were further explored through molecular docking studies, which identified strong interactions between oil-derived compounds and fungal target proteins. The combined findings highlight the potential of Moringa and Ylang Ylang essential oils as eco-friendly, biodegradable biofungicides for the management of southern corn leaf blight. This work contributes to integrated pest management strategies that align with environmental sustainability and offers a foundation for future development of essential oil-based formulations.

Key words : *Bipolaris maydis*, Essential oils, Moringa,Ylang Ylang, Antifungal activity, HPLC, Molecular docking

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Eco-Friendly Synthesis and Applications of Mushroom-Derived Nanoparticles: A Green Nanotechnology Approach

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Nanotechnology has emerged as a frontier in modern science with wide-ranging applications in medicine, agriculture, food security and environmental management. Among various biological systems, mushrooms (basidiomycetous macro-fungi) have gained special attention for their ability to act as natural bio-factories for the green synthesis of metallic nanoparticles (NPs). The general procedure for myco-synthesis involves the preparation of mushroom extracts from fruiting bodies, mycelial filtrates or purified biomolecules such as polysaccharides and proteins. These extracts are incubated with aqueous solutions of metal precursors such as silver nitrate ($AgNO_3$), chloroauric acid ($HAuCl_4$) or sodium selenite (Na_2SeO_3). Biomolecules within the extract mediate the reduction of metal ions into nanoparticles, while simultaneously providing natural capping for stability. The formation of nanoparticles is confirmed by UV-visible spectroscopy, whereas X-ray diffraction (XRD), dynamic light scattering (DLS), Fourier-transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM) and transmission electron microscopy (TEM) are employed to characterize their crystalline structure, functional groups, morphology and size distribution. Mushroom-derived nanoparticles, particularly silver (Ag NPs), gold (Au NPs), and selenium (Se NPs), have demonstrated promising activities against human and plant pathogens, showing strong antimicrobial, antioxidant and anticancer properties. Their applications extend to drug delivery, food packaging, biosensors and nano-biosorbents for the removal of toxic metals, contributing to both biomedical advancements and environmental sustainability. Thus, mushroom-mediated nanoparticle synthesis represents an innovative interface between nanotechnology and biotechnology. By harnessing the natural potential of mushrooms, this approach not only reduces dependence on hazardous chemicals but also opens new avenues for eco-friendly and sustainable nanomaterial production with significant implications in agriculture, healthcare, and environmental management.

Keywords: Mushrooms, Myco-nanotechnology, Metallic nanoparticles, Green synthesis, Sustainable applications

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Adsorption-Desorption of Micronutrients under Different Land Uses of District Ganderbal

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The present investigation describes adsorption and desorption of micronutrients in soils under different land uses. Surface soil samples (0-25 cm) were collected from fifteen locations which covered three land uses viz. agriculture, horticulture and forestry of district Ganderbal. The soils varied widely in their physico-chemical characteristics. Adsorption of micronutrients (Zn, Cu, Mn and Fe) was investigated on the collected soil samples using 50 ml of 0.01 M $CaCI_2$ solution containing graded concentrations of Zn, Cu, Fe and Mn of strength 0, 5, 10, 20, 30, 40, 50 and 100 mg L^{-1}. It was observed that with increase in concentration, the adsorption of micronutrients increased with corresponding decrease in per cent adsorption. The data of micronutrient adsorption fitted best to the Langmuir isotherm for Zn and Cu and Freundlich isotherm for Mn and Fe. The desorption of micronutrients was lower than the adsorption by soils, however per cent of desorbed micronutrients was higher at higher levels of pre-adsorbed micronutrients under all land uses. Micronutrient desorption obeyed the Langmuir equation over the most of the concentrations and desorption maxima (Dm) was higher in fine textured than in coarse textured soils. The average content of adsorbed micronutrients followed the order Fe > Mn > Cu > Zn and were highest in forestry followed by horticultural land use and lowest in agricultural land use. Likewise, the average content of desorbed micronutrients followed the order Zn > Cu > Mn > Fe and were highest in agriculture followed by horticulture and forestry. Cation exchange capacity, pH, clay and organic matter content were the prime factors governing micronutrient adsorption and desorption. The investigation explores processes of micronutrient (Zn, Cu, Mn and Fe) adsorption and desorption which in turn can help in devising suitable management strategies to facilitate their fixation and release by our soils.

Key words: Adsorption, Freundlich isotherm, Langmuir isotherm, Desorption, Micronutrients, Land uses.

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Agri-Food Trade and WTO Policies: Implications for Smallholder Farmers

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The World Trade Organization (WTO) framework has shaped global agri-food trade by reducing tariffs and opening markets. For India, agricultural exports have increased, yet the benefits remain unevenly distributed. Smallholders, who constitute 85% of India's farmers, often lack access to quality inputs, finance, and global value chains, which constrains their participation. India's stand on domestic support subsidies and public stockholding of food grains has sparked international debates, as policies like MSP procurement are often perceived as trade-distorting. While export bans and minimum export prices aim to stabilize domestic markets, they create uncertainty in global trade partnerships. Moreover, compliance with international sanitary and phytosanitary (SPS) standards limits smallholder competitiveness in exports of fresh produce, dairy, and organic products. To integrate smallholders into global trade, policy reforms must focus on capacity building, farmer producer organizations (FPOs), and digital trade facilitation. Linking WTO negotiations with farmer-centric reforms can ensure equity in global integration, supporting SDG 1 (No Poverty), SDG 2 (Zero Hunger), and SDG 10 (Reduced Inequalities).

Keywords: WTO, Agri-food trade, Smallholder farmers, SPS standards, Global integration

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Sustainable Food Preservation through Edible Coatings Developed from Agro-Industrial By-Products

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Perishable commodities spoil rapidly and which faces a major challenge in the food industry. Another challenge for the food industry is the excessive use of synthetic packaging materials, which contribute to environmental pollution. An innovative and sustainable approach to improve food quality, extend the shelf life and reduce the postharvest losses is the utilization of edible coatings derived from agro-waste. The agro-industry creates huge by-products like vegetable residues, fruits peels, and cereal husks which are rich in polysaccharides, proteins, and bioactive compounds which can be effectively utilized into sustainable and functional coating materials. These coatings act as biodegradable barriers against moisture, gas exchange, and microbial spoilage while minimizing reliance on synthetic packaging. Moreover, their natural antioxidant and antimicrobial properties improve nutritional and sensory attributes of perishable foods. The peel extract of banana blended with chitosan forms coatings rich in antioxidants that inhibits moisture loss and prolongs the shelf life of the fruits. Chickpea hull polysaccharide films enhance antioxidant and antimicrobial activity, offering protection against spoilage microbes and Chili pepper seed protein–fibre films provide strong antimicrobial barriers while valorising processing waste. The utilization of agro-waste into edible coatings contributes hugely to a circular economy by converting food industry waste into high value functional applications in the food industry. In addition to this, it also addresses global concerns environmental pollution and food waste management.

Keywords: Agro-waste utilization, Edible coatings, Shelf-life extension, Biodegradable packaging, Circular economy

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Isolation, Identification and Molecular Detection of Aeromonas Species in Raw Milk from Dairy Animals

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This study investigated the prevalence of *Aeromonas* species in 210 raw milk samples collected from cattle, buffalo, and goats in rural areas of Navsari and Surat districts, India. Using a combination of enrichment, selective plating, biochemical tests, and molecular detection with the 16S rRNA gene, a 21% overall prevalence rate was found, with 44 isolates recovered. The highest prevalence was observed in cattle milk (22.8%), followed by goat (21.4%) and buffalo (18.5%) milk. The most predominant species identified were *A. hydrophila* (15.7%) and *A. caviae* (5.23%). The study also calculated the odds ratio and relative risk, revealing a higher possibility of infection from cattle milk compared to buffalo milk.

The antibiotic sensitivity of the isolates was tested against 12 different antibiotics using the agar disc diffusion method. The results showed high sensitivity towards chloramphenicol, ciprofloxacin, and nalidixic acid, while 100% of the isolates were resistant to penicillin G. A multi-drug resistance (MDR) index indicated that 12.06% of *A. hydrophila* isolates and 18.18% of *A. caviae* isolates were resistant to more than three antibiotics. The findings highlight the presence of *Aeromonas* in raw milk and significant levels of antibiotic resistance, posing a potential public health risk. The study concludes with a call for more stringent hygienic practices at dairy farms and a more judicious use of therapeutic antibiotics.

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Performance of Lettuce cv. Phule Padma under Different Hydroponic Systems

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Hydroponics represents a transformative approach in modern agriculture, offering a sustainable alternative to traditional soil-based farming. By enabling year-round cultivation and minimizing resource input, especially water, it addresses challenges posed by climatic variability and land constraints. The present study, entitled *"Performance of Lettuce cv. Phule Padma under different Hydroponic Systems"*, was undertaken to evaluate the performance of lettuce (cv. Phule Padma) under different hydroponic systems. The research was conducted at the Instructional-cum-Research Farm of the Horticulture Section, Rajarshee Chhatrapati Shahu Maharaj College of Agriculture, Kolhapur, during the rabi season of 2024–25, spanning January 2025 to March 2025. The experiment consisted of eight treatments: Ebb and flow (T1), NFT (Vertical) (T2), Wick method (T3), Deep water culture (DWC) (T4), Drip and Drain method (T5), NFT (Slanting) (T6), NFT (Horizontal) (T7) Protected soil-less media-based cultivation (T8). Five representative plants from each treatment were selected for recording observations at weekly intervals post-transplanting. Analysis of variance (ANOVA) followed by Duncan's Multiple Range Test (DMRT) at $P \leq 0.05$ was used to test the significance of differences among treatments. Results indicated highly significant variations across treatments. Among all systems, Drip and drain (T5) recorded the highest vegetative growth with leaf length of 14.85 cm, plant height of 24.97 cm, and 14.53 leaves per plant, along with superior plant spread (28.50 cm) and leaf width (5.49 cm). Also, Drip and drain (T5) excelled in terms of quality, nutrient uptake, and biochemical parameters, including phosphorus (0.52 %) and iron (100.67 mg/kg). Drip and drain (T5) harvested very early as compared to other systems within 35 DAT showed earliness characteristics, while systems like Pot cultivation (T8) and NFT Slanting (T6) delayed in harvesting up to 43.67 and 42.67 DAT resp. Also, Drip and drain (T5) topped in sensory attributes such as texture (8.70) and crispiness (9.00) while Wick Method (T3) showed good firmness rating (8.80).

In terms of yield, Drip and drain (T5) gives maximum fresh weight per plant (252.35 g) and per m² Wick method (T3) gives (8202.11 g). However, hydroponic systems like NFT Vertical (T2) (180.58 g/plant) and per m2 Ebb and flow (T1) gives (7357.55 g/m²) and DWC (T4) (158.23 g/plant; 6933.54 g/m²) closely matched the yield potential, with added benefits of improved quality, reduced crop cycle, and water savings. The least effective systems were Pot cultivation (T8) (129.52g/plant) and NFT Slanting (T6) (136.91 g/plant) owing to inadequate nutrient absorption and poor root development, resulting in reduced growth and yield.

In conclusion, Drip and drain method (T5) emerged as the most effective hydroponic system for lettuce cultivation, offering superior biochemical quality, sensory appeal, and nutritional value, making it highly suitable for commercial urban farming. Despite the head formation being more pronounced in open field conditions due to the variety's characteristics, hydroponic systems, especially the Drip and drain method demonstrated significant advantages, confirming their potential as a sustainable, high-efficiency alternative for year-round lettuce production.

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Physicochemical Properties and Soil Amendment Potential of Biochar Produced from Cashew Shell Waste

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Cashew shell biochar is rich in carbon and contains essential minerals like potassium, magnesium, calcium, copper, zinc, and iron, making it a valuable fertilizer for agricultural use. Its alkaline pH helps increase soil fertility and improve plant growth and yield. This study investigates synthesis and physicochemical characterization of biochar derived from cashew shell biomass. The biomass was prepared by a slow pyrolysis process at 450 °C under an inert atmosphere. The biochar was then chemically activated using KOH, and H3PO4 and a comparative study was carried out between non-activated biochar and chemically activated one. The biomass and the biochar was analysed using proximate analysis to evaluate the moisture, volatile material ash content and fixed carbon content. The cashew biomass exhibited a moisture content of 7.2%, volatile matter of 70.3%, and ash content of 5.7%, and fixed carbon of 16.8 %, indicating high organic content and suitability for biochar production. Three different types of biochar were prepared: non-activated biochar (CB), KOH-activated biochar (CB-KOH), and H_3PO_4-activated biochar (CB-H_3PO_4). The non-activated biochar (CB) retained moderate porosity and surface area, with limited diversity of functional groups. In contrast, CB-KOH exhibited a significant enhancement in surface area up to 475 m2/g and pore development due to the etching and expansion effects of alkaline activation, thereby facilitating a greater adsorption potential. CB-H_3PO_4 demonstrated improved mesopores and oxygenated functional groups, attributed to the dehydrating and cross-linking action of phosphoric acid during pyrolysis. FTIR spectra confirmed the presence of hydroxyl, carboxyl, and phosphate groups in CB-H_3PO_4, while CB-KOH showed intensified C–O and C=C stretching bands, reflecting enhanced graphitization.

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Geospatial modelling for delineation of crop management zones using Soil attributes

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Mapping of soil properties using the Geographical Information System (GIS) is an important aspect as it plays a vital role in the knowledge about the soil properties and how it can be used sustainably. The study was carried out in rice growing soils of Veeranam Command area, of Cuddalore district. to map soil available nutrients and assess their variability. A grid pattern (1 x 1 km) was established at the experimental farm to collect surface soil samples (0-15 cm). The soil samples were analyzed for available Nitrogen, Phosphorus, Potassium, pH, Electrical Conductivity (EC) and soil organic carbon (SOC). The location of the sampling points and field boundary were marked with a GPS. Descriptive statistics and geostatistical analysis were done. The results reveal that pH of surface soils varied from 6.55 to 8.30with CV of 6.34 per cent. The EC exhibited very high variability. The pH, organic carbon and available N showed less variability whereas, available P and K exhibited high variability. Geostatistics was used to estimate and map nutrients in unsampled areas. The spatial dependence classes were strong for pH, whereas all other soil properties exhibited moderate spatial dependence. Spatial distribution maps of soil available nutrients made using Arc GIS software. Most of the research area showed evidence of multinutrient deficiency. Critical nutrient deficiency zones were identified. Additionally, it would aid in lowering the quantity of inorganic (fertilizer) inputs provided to the soil as supplements in order to prevent overburdening the soil, which could result in pollution and the degradation of the land. The study also shows that geostatistics and GIS is an effective tool for regionalized nutrient management.

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Assessment of Soil Fertility and Nutrient Management Strategies in Veeranam Command Area: A case study using the Nutrient Index Value Method

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The experiment delineated macronutrient and micronutrient availability in the soils of Veeranam command area using the Nutrient Index Value (NIV) method. A total of 238 soil samples were collected and analyzed for their pH, electrical conductivity (EC), organic carbon (OC), and the availability of primary macronutrients like nitrogen (N), phosphorus (P), potassium (K), and essential micronutrients including zinc (Zn), copper (Cu), iron (Fe), and manganese (Mn). Soil pH values ranged from 5.95 to 8.30, with a mean of 7.59, indicating variability from slightly acidic to moderately alkaline conditions. Approximately 72% of the samples exhibited alkaline pH (>7.0). Electrical conductivity (EC) ranged from 0.15 to 2.34 dS/m, with an average of 0.67 dS/m, classifying the soils as non-saline and favorable for agricultural use. The OC content ranged from 0.41% to 0.88%, with a mean of 0.66%, placing 71.8% of samples in the medium fertility category. Nitrogen availability was critically low across all samples (100%) with a mean of 201.94 kg/ha, indicating a substantial deficiency and NIV value of 1.0 Potassium status was relatively better, with 63.02% of samples in the medium range and 36.9% in the high category (mean = 295.75 kg/ha; NIV = 2.36).Among micronutrients, zinc was critically deficient, ranging from 0.12 to 1.79 mg/kg with a mean of 0.61 mg/kg. Approximately 92.8% of the samples were low in available Zn, and its NIV value was very low (1.07). Iron levels varied from 2.02 to 20.16 mg/kg with a mean of 9.31 mg/kg, and 56.7% of samples exhibited high availability (NIV = 2.43). Copper showed an average of 2.33 mg/kg and was adequately available in 50.4% of the samples, with an NIV of 2.1. Manganese content ranged from 0.59 to 8.26 mg/kg with a mean of 2.66 mg/kg; 47.4% of samples fell under medium category and the NIV was marginal (1.78).

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Resistance identification, biochemical insights and management approaches for dry root rot of cowpea

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Cowpea [*Vigna unguiculata* (L.) Walp.], an important annual legume, is highly susceptible to dry root rot caused by *Macrophomina phaseolina*. During summer 2024, diseased roots showing typical symptoms were collected from RARI farm, Durgapura. The pathogen was isolated, purified through the hyphal tip method, and its pathogenicity confirmed using soil inoculation under pot and field conditions. Morphological characterization of mycelia using primers ITS1/ITS4, confirmed the identity of the pathogen as *M. phaseolina* (GenBank Accession No. PQ399952). To identify resistance sources, thirty-five cowpea entries were screened under sick plot conditions. None were found immune, but four entries, *viz.*, CPD 307, CPD 347, CPD 332, and CPD 324, exhibited moderate resistance. Biochemical assays indicated distinct defense responses between resistant and susceptible groups. Moderately resistant entries showed a marked increase in phenolic content at 96 hours post-inoculation (hpi), while susceptible entries recorded a decline after 72 hpi. Proline accumulation did not vary significantly; however, total antioxidant enzyme activity rose sharply at 48 hpi in moderately resistant entries, whereas the increase was less pronounced in susceptible ones. Field evaluation of eight management treatments revealed that seed treatment with Azoxystrobin 2.5% + Thiophanate Methyl 11.25% FS + Thiamethoxam 25% FS was most effective, reducing disease incidence to 20.27% and enhancing grain yield to 6.88 q/ha. Bioagents, *Trichoderma harzianum* and *T. asperellum*, also reduced disease by more than 50%. These results demonstrate the existence of partial resistance in cowpea and highlight the efficacy of integrated chemical and biological management strategies against *M. phaseolina*.

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Dual-Strategy Water Conservation in Dryland Maize: Synergistic Effects of Organic Mulching and Antitranspirant Technology

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Water scarcity severely limits maize productivity in India's semi-arid regions, where 70% of agricultural land relies on rainfall. This study examined how combining organic mulching with kaolin clay antitranspirant applications affects dryland maize performance. We conducted a field experiment during the 2020 kharif season in Kadapa district, Andhra Pradesh, testing four organic mulches (paddy straw, groundnut haulm, coir-pith, sugarcane trash) with kaolin clay foliar spray (3.0%) using a randomized block design with nine treatments and three replications.

Results showed that coir-pith mulch with kaolin clay applied at 20 and 40 days after sowing produced the highest grain yield (6,976 kg ha^{-1}), a remarkable 55.7% increase over farmer's practice (4,479 kg ha^{-1}). This treatment also achieved superior plant height (219.33 cm), leaf area index (6.26), and dry matter production (15,467 kg ha^{-1}). Strong correlations ($r > 0.99$) between all parameters indicated integrated physiological responses. Economic analysis revealed attractive returns with a benefit-cost ratio of 2.64 and net profit of ₹89,460 ha^{-1}.

Our findings demonstrate that this dual-strategy approach offers practical, cost-effective solutions for enhancing dryland maize productivity using locally available resources, providing smallholder farmers with accessible water conservation technologies.

Keywords: Dryland agriculture, organic mulching, antitranspirant, kaolin clay, water conservation, Zea mays, semi-arid regions

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Silkworm Litter Based Liquid Organic Manure: A Sustainable Approach to Soil Fertility and Microbial Enrichment in Mulberry Cultivation

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Mulberry (*Morus* sp.) is a deep-rooted high biomass producing foliage crop which is the sole food source for silkworm, *Bombyx mori* L. Hence, Mulberry growth and nutritional quality are critical for successful sericulture. Silkworm litter, a by-product of silkworm rearing is rich in organic matter and essential nutrients, making it a potential resource for recycling into organic manure. To explore the effectiveness of silkworm litter as liquid organic manure a study was conducted at the Department of Sericulture, UAS, GKVK, Bengaluru, during 2023-2024. The results of the experiment revealed that the Silkworm litter based liquid organic manure (SLLM) had slightly alkaline pH (7.68) with notable nutrient content *viz.*, NPK (3.02 %, 1.22 %, 2.96 % respectively) and micronutrients Fe (1,116.20 ppm), Zn (73.80 ppm), Cu (14.10 ppm) and Mn (268.60 ppm). The manure contained a significant population of fungi (3.33 X 10^2 cfu ml^{-1}), bacteria (52.24 X 10^6 cfu ml^{-1}) and actinomycetes (66.58 X 10^4 cfu ml^{-1}). The study also explores the effectiveness of SLLM at different doses along with Recommended Dose of Fertilizers (RDF) in enhancing soil nutrients and microbiota. The treatment RDF + Soil drenching of 250 l $acre^{-1}$ of 20 % SLLM at 10 Days after pruning (DAP) + Foliar spray of 150 l $acre^{-1}$ of 10 % SLLM at 25 DAP (T_9) recorded maximum organic carbon content (0.82 %), NPK content (413.80, 32.43, 254.07 kg/ha respectively), micronutrients *viz.*, Fe (2.72 ppm), Zn (2.64 ppm), Mn (32.06 ppm) and Cu (0.92 ppm) along with maximum soil bacteria (51.83 X 10^6 cfu g^{-1}), fungi (6.50 X 10^2 cfu g^{-1}) and actinomycetes (61.20 X 10^4 cfu g^{-1}) besides suppressing pathogen load. This shows that application of SLLM to soil in mulberry garden serves as an eco-friendly and efficient organic amendment for improving soil fertility and productivity in sericulture based agroecosystems contributing to both organic sericulture and circular bio-resource management.

Keywords: Silkworm litter, Liquid manure, Mulberry, Soil fertility, Soil microbiota

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Compatibility and Toxicity of *Metarhizium Anisopliae* with Plant Derived Pesticides against *Spodoptera Litura*

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Investigation entitled "compatibility and toxicity of *Metarhizium anisopliae* with plant derived pesticides against *Spodoptera litura*" was conducted at Department of Entomology, Dr. PDKV, Akola during the year 2022-23. The experiment on compatibility of *M. anisopliae* with plant derived pesticides consisted of five treatments, each replicated four times. The experiments were carried out in completely randomized design. The data on colony diameter of *M. anisopliae* in each treatment were collected at 10 days after inoculation and finally the percent inhibition of mycelial growth was calculated to test the compatibility of *M. anisopliae* with plant derived pesticides.

Similarly, among the tested plant derived pesticides Azadirachtin 0.03% EC turned out to be most compatible with *M. anisopliae*. The next best treatment was Azadirachtin 0.15% EC which found at par with Azadirachtin 0.30% EC. However, treatments viz., Azadirachtin 0.03% EC, Azadirachtin 0.15% EC and Azadirachtin 0.30% EC showed less than 50 per cent mycelial growth inhibition of *M. anisopliae* and proved harmless as per the classification scheme given by Hassan (1989). In case of toxicity of *M. anisopliae* alone and in combination with plant derived pesticides against third instar larvae of *Spodoptera litura* at 3 days after treatment, Azadirachtin 1.00% EC showed the highest larval mortality. However this was at par with treatments viz., Azadirachtin 1.00 % EC + *M.anisopliae* , Azadirachtin 0.30 % EC + *M. anisopliae*, Azadirachtin 0.15 % EC + *M.anisopliae*, Azadirachtin 0.30 % EC. At 7 days after treatment, Azadirachtin 1.00% EC turned out to be the best treatment. This treatment was found at par with Azadirachtin 1.00 % EC + *M.anisopliae*, Azadirachtin 0.30 % EC, Azadirachtin 0.30 % EC + *M.anisopliae* and Azadirachtin 0.15 % EC + *M.anisopliae*. However, at 10 days after treatment Azadirachtin 1.00% EC and Azadirachtin 1.00 % EC + *M.anisopliae* emerged as most effective treatment. These treatments were found statistically equal to Azadirachtin 0.30 % EC + *M.anisopliae*, Azadirachtin 0.15 % EC + *M.anisopliae*, Azadirachtin 0.30 % EC, Azadirachtin 0.03 % EC + *M.anisopliae*, Azadirachtin 0.15 % EC and *M. anisopliae* alone (1×10^8 conidia/ml). The combination of *M. anisopliae* with plant derived pesticides showed a synergistic effect and led to higher mortality of the *S. litura*. This control solution could mitigate potential issues related to environmental contamination, non-target impacts and pesticides resistance.

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Impact of Long-Term Fertilization and Organic Manuring on Soil Enzyme Activities in Soybean Fields

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A long-term field experiment was conducted at the AICRP Research Farm, College of Agriculture, Indore (Madhya Pradesh, India), to assess the impact of integrated nutrient management practices on soil enzyme activities in soybean cultivation. The study was laid out in a randomized block design with three replications, evaluating combinations of chemical fertilizers (N, P) and farmyard manure (FYM). Soil samples were collected after crop harvest at four depths (0–10, 10–20, 20–30, and 30–40 cm) and analyzed for Dehydrogenase (DHA), Urease, Acid and Alkaline Phosphatase, and Arylsulfatase activities. Results revealed that treatment T6 (FYM @ 6 t ha^{-1} + $N_{(20)}$ $P_{(13)}$) significantly enhanced all enzymatic activities across all soil depths, indicating improved microbial activity and soil health. The findings highlight the critical role of organic manuring combined with balanced fertilization in sustaining soil biochemical functions under soybean cropping systems.

Keywords: Soil enzymes, Dehydrogenase, Urease, Phosphatase, Arylsulfatase, Soybean, FYM, Long-term fertilization, Soil health

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Quantifying the Tree biomass and Carbon Stock of four important multipurpose tree species of mid-hills of Arunachal Pradesh

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Carbon fixation through forestry is a function of the amount of biomass in a given area. Plantations are a very efficient way of promoting biomass and carbon accumulation. *Manglietia insignis, Altingia excelsa, Ixonanthus Khasiana, and Gmelina arborea are* multipurpose trees of Arunachal Pradesh producing timber, fuelwood, fodder, pulp, honey etc. An experiment was conducted at ICAR Research Farm, Basar, to quantify the effect of spacing on biomass and carbon stock of plantations of these tree species. The block plantations of these trees were established in the year 1999. The Girth at Breast Height (GBH) of trees in sample plots was recorded in plantations. The allometric equations relating the Girth at Breast Height (GBH) and biomass of different tree components were developed by felling 15 trees of each species and measuring dry wight of each of tree components. These allometric equations were used for estimation of the tree component wise biomass of each species. The carbon concentration of tree components was estimated using standard procedures. The component-wise carbon stock was estimated by multiplying biomass with respective carbon concentration. The plantation of *Altingia excelsa* recorded the highest bole biomass (244.79±18.57 t ha^{-1}), branch biomass (63.35±3.97 t ha^{-1}), foliage biomass (37.77±2.97 t ha^{-1}), root biomass (76.55±5.43 t ha^{-1}) and total biomass (422.47±27.54 t ha^{-1}) followed plantation of *Manglietia insignis* having bole biomass (186.00±9.87 t ha^{-1}), branch biomass (35.16±3.41 t ha^{-1}), foliage biomass (36.95±4.43 t ha^{-1}), root biomass (59.76±7.98 t ha^{-1}) and total biomass (317.89±20.87 t ha^{-1}). The plantation of *Altingia excelsa* also recorded the highest carbon stock in bole (106.48±6.32 t ha^{-1}), branch biomass (28.93±1.97 t ha^{-1}), foliage (17.62±1.08 t ha^{-1}), root (27.36±1.56 t ha^{-1}) and total carbon stock (180.41±7.34 t ha^{-1}) followed plantation of *Manglietia insignis* having carbon stock in bole (80.91±6.38 t ha^{-1}), branch (16.06±2.13 t ha^{-1}), foliage (17.24±2.06 t ha^{-1}), root (21.36±1.88 t ha^{-1}) and total carbon stock (135.58±8.65 t ha^{-1}). This study concludes that closer the plantations of *Altingia excelsa* has the highest biomass and hence, the highest carbon stock per unit area.

Key words : Spacing, biomass, carbon stock

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Circular Economy and Waste Valorization in Agriculture – A review

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The growing challenges of climate change, resource depletion, and waste accumulation demand a fundamental transformation in global agriculture. The circular economy offers a resilient solution by promoting resource efficiency, waste reduction, and regeneration of natural systems. A central component of this approach is waste valorization—the process of converting agricultural and food waste into valuable products such as compost, bioenergy, animal feed, and bioplastics. Globally, over 1.3 billion tonnes of food are wasted annually, accounting for approximately one-third of all food produced, while more than 80% of crop biomass remains underutilized as waste. In India alone, over 500 million tonnes of agricultural residues are generated annually, with only a fraction being effectively used. Recent studies reveal that 84.4% of crop residues in regions like Andhra Pradesh are primarily used as livestock feed, leaving a significant portion available for energy recovery and soil amendments. Similarly, municipal organic waste, if composted and integrated into peri-urban farming, can meet 21% of synthetic fertilizer needs while reducing greenhouse gas emissions by up to 39%. Despite increasing awareness, global circularity has declined, with only 6.9% of the 106 billion tonnes of materials consumed in 2023 being recycled or reused—down from 9.1% in 2018. This highlights the urgency of integrating circular models into agricultural systems. Technologies such as anaerobic digestion, pyrolysis, and decentralized composting offer scalable solutions for waste valorization, contributing to soil health, carbon sequestration, and rural income diversification. To maximize impact, strong policy frameworks, financial incentives, decentralized waste infrastructure, and farmer-centric innovations are essential. Embedding circular economy principles in agriculture not only enhances sustainability but also opens pathways for climate mitigation, food security, and green economic growth.

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Making Dairy Smarter for a Sustainable Future

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The dairy industry's got a big job ahead – feeding more people while being kinder to the planet. We're looking at how the latest dairy tech can help make this happen. Think smarter ways to use resources, precision farming to get the best out of dairy operations, and maybe even tapping into renewable energy to cut down on emissions. Of course, there are challenges like needing more upfront cash, getting the right skills in place, and making sure the rules help us move in the right direction.

The bottom line? When we mix cutting-edge dairy tech with sustainable practices – and maybe get a bit of support from governments – we could be onto something big. It could help us match dairy supply with demand, keep food safe and nutritious, and basically future-proof dairy farming.

Keywords: Dairy tech, sustainable dairy, precision farming, going green in dairy, food security, FutureAG 2025

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Components of Agriculture Policy in India

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India's new agriculture policy focuses on increasing farmer income, promoting sustainable and climate-resilient farming, enhancing market access through digital tools and infrastructure, and ensuring food security. Key initiatives include boosting productivity with new programs like the PM DHAN-Dhaanya Krishi Yojana, modernizing the Minimum Support Price (MSP) system, integrating technology for efficiency, and improving post-harvest infrastructure. The policy also emphasizes resource management, crop diversification, and supporting small farmers through Farmer Producer Organizations (FPOs). The policy prioritizes reducing the environmental impact of farming and adapting to climate change to ensure long-term viability and reduce crop losses. This is a central goal, achieved through a modernized MSP system, targeted financial support, smart insurance schemes, and market reforms that ensure better prices for produce. The adoption of digital agriculture, including satellite monitoring, AI, and online marketplaces, is crucial for improving efficiency and transparency. Focus is placed on developing essential infrastructure, such as cold chains, warehousing, and logistics, to reduce post-harvest losses and improve supply chains. The policy aims to create a unified national market for agricultural commodities and strengthen direct links between producers and buyers, promoting contract farming. Sustainable management of natural resources, including soil health and water-efficient irrigation, is a core component. These efforts are directed toward supporting small and marginal farmers by providing access to credit, tailored extension services, and promoting Farmer Producer Organizations (FPOs), initiatives like the National Mission on Edible Oils – Oilseeds (NMEO-Oilseeds) aim to enhance domestic production in key areas to achieve self-reliance.

Key words: PM DHAN-Dhaanya Krishi Yojana, Minimum Support Price (MSP), Farmer Producer Organizations (FPOs).

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Impact of Harsh Climate on Women's Health and Nutrition in Changthang

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The Changthang region lies in the eastern part of Ladakh (India), extending into western Tibet. Altitude: 4,200–5,500 m above sea level. Changthang is cold-arid desert with harsh winters (–30°C to –40°C).Short growing season (May–September).Low annual rainfall (<100 mm) and High-altitude plateaus, lakes (Tso Moriri, Pangong Tso, Tso Kar), and vast pastures. Fragile ecosystem with sparse vegetation. In Changthang **Small Farmers (Settled in Villages)** Cultivate **barley, wheat, peas, mustard, vegetables** in short summer season and Depend on **glacier melt irrigation** and small streams. Changthang **Women in Agriculture is the backbone** of nomadic & settled agriculture. They are involved in **milking, fodder collection, kitchen gardening, wool processing, handicrafts** and managing households and animals when men migrate. **General Health Challenge's harsh climate & high altitude** (4,000–5,000 m) causes respiratory problems, altitude sickness, and hypoxia. Joint pain and fatigue from heavy physical work and **Nutritional deficiencies** due to limited diet (mostly barley, meat, milk; fewer vegetables/fruits).

Keywords: Changthang, Nutrition, Health, Women

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Enhancing Functional Performance of Bagasse-Based Biodegradable Cutlery Using Neem Wax Coatings

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The global rise in single-use plastics has accelerated the search for sustainable alternatives in food packaging and tableware. Bagasse, an agro-waste byproduct of sugarcane processing, has emerged as a promising raw material for biodegradable cutlery due to its renewable origin, fibrous structure, and relatively low cost. However, its inherent hydrophilicity significantly limits its performance under wet, hot, or oily food conditions, reducing both durability and consumer acceptance. Neem wax is chosen for its hydrophobicity, biodegradability, and well-documented antimicrobial properties, making it an ideal candidate to enhance both functional and hygienic attributes of biodegradable tableware. Uncoated and neem wax–coated bagasse cutlery samples were systematically analyzed for moisture absorption, water contact angle, tensile strength, tear resistance, and biodegradation behavior under controlled composting conditions. Additional microbial resistance assays were conducted to evaluate the antimicrobial efficacy imparted by the neem wax coating. The results demonstrated a significant reduction in moisture uptake and an improvement in water repellency for coated samples compared to uncoated ones. Furthermore, biodegradation studies indicated that the coating did not compromise the compostability of the material, with complete disintegration observed within acceptable timeframes. The antimicrobial assessment confirmed that neem wax imparted inhibitory effects against common foodborne microorganisms, highlighting its dual role as a protective and functional bio-based additive. This study establishes neem wax–coated bagasse cutlery as a viable, eco-friendly alternative to conventional plastic disposables, offering improvements in hydrophobicity, durability, and microbial safety while remaining biodegradable. The findings underscore the potential of integrating natural coatings with agricultural byproducts to design next-generation sustainable food contact materials.

Keywords: Bagasse, Biodegradable cutlery, Neem wax, Mechanical properties, Compostability, Sustainable packaging

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Effect of Supplementation of Tulsi Leaf Powder (*Ocimum Sanctum*) and Vitamin E on Carcass Characteristics and Organometry of Broiler Chicks

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The aim of this study was to determine the effect of supplementation of Tulsi leaf powder (*Ocimum sanctum*) and vitamin E powder in the ration of Broiler chicks on carcass characteristics and organometry. In the study 360 birds of day-old-broiler chicks were used. The birds were divided into ten treatments having three replicates in each group with 12 birds in each replicate. The treatment T1 *i.e*. control group fed with unsupplemented diet and T2 (0.25% Tulsi leaf powder), T3 (0.50% Tulsi leaf powder), T4 (0.75% Tulsi leaf powder), T5 (1.0% Tulsi leaf powder), T6 (0.025% vitamin E), T7 (0.25% Tulsi leaf powder and 0.025% vitamin E), T8 (0.50% Tulsi leaf powder and 0.025% vitamin E), T9 (0.75% Tulsi leaf powder and 0.025% vitamin E) and T10 (1.0% Tulsi leaf powder and 0.025% vitamin E) supplemented along with basal diet, respectively. The results of the study revealed a significant effect on dressing weight per cent and abdominal fat per cent due to Tulsi leaf powder and Vitamin E supplementation. Eviscerated yield and relative weight of immune organs showed no-significant effect due to various treatment groups of Tulsi leaf power and various parts of intestinal tract measurement showed no-significant effect due to Tulsi leaf powder and Vitamin E supplementation.

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Constraints Faced by Dairy Farm Women while Adopting Scientific Dairy Management Practices: A Study in Yavatmal District, Maharashtra

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Dairy farming in the Yavatmal district of Maharashtra, India, is a crucial agricultural activity with significant growth potential. However, women dairy farmers in the region face a unique set of interconnected constraints that limit their ability to adopt modern and scientific dairy management practices. This study aimed to identify and rank the most significant constraints faced by women dairy farmers in the Yavatmal district. A total of 200 respondents were purposely selected from five villages in the Darwha Block and interviewed using a well-structured and pre-tested interview schedule. The collected data were tabulated and analyzed using simple statistical methods. The results revealed that economic pressures and high costs were the most impactful challenges, with low milk prices (86.5%), high concentrate prices (84%), and high charges by private practitioners (68%) being the top three constraints. Mid-tier constraints included breeding and feed challenges, such as the non-availability of specific breed semen (61.5%) and green and dry fodder (60.5%). Operational efficiency issues, such as a shortage of skilled milking personnel (51.5%) and poor availability of concentrates and mineral mixtures (49%), were also identified. Infrastructure, labor, and extension gaps were among the bottom-tier constraints of the study. These findings highlight the need for targeted interventions and support systems to empower dairy farm women and enhance the adoption of scientific dairy management practices in the Yavatmal district, ultimately leading to improved productivity, efficiency, and overall sustainability in the dairy farming industry.

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CRISPR/Cas9-Assisted Functional Validation of Stress-Responsive Genes for Climate-Resilient Crop Development

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Climate stresses like drought, salinity, heat, and nutrient imbalance continue to challenge agricultural production and have a serious impact on world food security. Conventional breeding and transgenic strategies have played a major role in improving crops but their lack of accuracy and extended periods discourage their application to counter the fast-emerging climatic problems. In this respect, the CRISPR/Cas9 genome-editing system has become a disruptive technology in functional genomics and crop enhancement. Special attention is given to regulatory genes, such as transcription factors (NAC, WRKY, DREB, and bZIP domains), ion transport machinery, genes of osmoprotein synthesis, and hormone signaling parts that coordinate the plant response in response to abiotic stress. Together, CRISPR/Cas9-mediated functional validation of stress-responsive genes constitutes a paradigm shift in the engineering of climate-resilient crops and provides sustainable solutions to providing the world with food and nutritional security.

Keywords: abiotic stress, CRISPR/Cas9, climate resilience, functional genomics, gene editing,

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CRISPR Technique for Fruit Crop Improvement: A Paradigm-Shifting Approach

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Targeted plant genome editing using sequence specific nucleases has a great potential for crop improvement to meet the increasing global food demands and to provide a sustainable productive agriculture system. Traditionally, the crops were being improved by the conventional and mutation plant breeding techniques, which are now getting constrained by the declining of existing genetic variation of plants, hampering the production for future feeding. There is an urgent need for efficient crop improvement strategies with novel genome editing techniques like the CRISPR /Cas9 system. In a few years, this technique has been trending vastly with numerous examples of targeted mutagenesis and targeted regulation of transcriptional control in model as well as crop plants which clearly demonstrates the revolutionary aspects of this novel system. The Clustered Regularly Interspaced Short Palindromic Repeats associated Cas9/sgRNA system is a novel targeted genome-editing technique derived from the bacterial immune system. It is an inexpensive, precise, most user friendly and rapidly adopted genome editing tool transforming to a revolutionary paradigm. This technique enables precise genomic modifications in many different organisms and tissues. Cas9 protein is an RNA guided endonuclease utilized for creating targeted double-stranded breaks with only a short RNA sequence to confer recognition of the target in animals and plants. Development of genetically edited (GE) crops similar to those developed by conventional or mutation breeding using this potential technique makes it a promising and extremely versatile tool for providing sustainable productive agriculture for better feeding of rapidly growing populations in a changing climate. With this powerful and innovative technique the designer GE non-GM plants could further advance climate resilient and sustainable agriculture in the future and maximizing yield by combating abiotic and biotic stresses.

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Crop Weather Calendar for Short Duration Rice (*Oryza Sativa* L.) Varieties in Central Kerala

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The study was conducted at the Agricultural Research Station, Mannuthy, Kerala Agricultural University, Thrissur, using a split-plot design with five planting dates (June 5th, June 20th, July 5th, July 20th, and August 5th) as main plots and two varieties (*Jyothi* and *Manu Ratna*) as subplots, replicated four times. Observations include: Phenological, weather, computed, yield, and yield attributes were recorded and analyzed using SPSS and R-studio software. Results revealed that increases in maximum and minimum temperature, temperature range, bright sunshine hours, and evaporation rate shortened crop duration, whereas rainfall, number of rainy days, and relative humidity positively influenced it. Significant variation was observed in computed parameters, with *Manu Ratna* exhibiting higher leaf area index and dry matter accumulation than *Jyothi*. Grain yield was highest in *Jyothi* under July 5th planting, while *Manu Ratna* recorded superior yield under July 20th planting, comparable with July 5th and August 5th plantings. A 40-year dataset (1983–2022) of weather parameters for central Kerala, was obtained from the Department of Agricultural Meteorology, College of Agriculture, Vellanikkara, to prepare a crop weather calendar for short-duration rice varieties during the *virippu* season. Climatic normals were derived, and phenophase-wise weather requirements for optimum yield were analyzed using Microsoft Excel. The analysis enabled identification of critical weather conditions corresponding to each phenophase, thereby establishing the specific climatic requirements for achieving optimum yield. Favourable weather conditions for pest and disease incidence were identified from relevant literature sources. These conditions were integrated into the crop weather calendar to anticipate potential outbreaks and support timely management strategies. Based on optimal weather data for achieving optimum yield, crop weather calendar has been developed for the *Jyothi* and *Manu Ratna* varieties. It was determined that, during the present condition, the best period for sowing of rice is during the 20th Standard Meteorological Week (SMW) *i.e.* around mid-May.

Keywords: Climatic normals, *virippus* season, Standard Meteorological Week, SPSS and split plot design

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Development of Antimicrobial Edible Packaging for Dairy Products

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The research in edible films and coatings, especially for perishable foods, has increased due to the growing demand for eco-friendly and biodegradable alternatives to synthetic packaging. Due to high moisture content, paneer is highly vulnerable to microbial spoilage and quality deterioration. In the present study, an antimicrobial edible film was developed using Whey protein Concentrate (WPC), Pectin and Glycerol as plasticiser incorporated with *Lactobacillus acidophilus*, a probiotic strain known for its inhibitory effect against spoilage and pathogenic microorganisms. The objective of this study was to evaluate the effectiveness of WPC-based edible film in enhancing the shelf life of paneer. The physicochemical properties, such as moisture content, pH, Titrable acidity, fat and protein, were evaluated during the storage period at refrigeration temperature. Moreover, the mechanical properties of the film, including tensile strength, elongation at break and barrier properties such as OTR and WVTR, were also monitored. The sensory properties, such as colour, aroma, texture, flavour and overall acceptability, were also assessed for the acceptance of the consumer. The results showed that the paneer samples wrapped with WPC–based antimicrobial films exhibited superior preservation compared to control samples. The control sample maintained the shelf life till 5 days, while the Film-wrapped paneer maintained the microbial safety till 13 days at refrigeration temperature. The overall study indicated that the WPC-based antimicrobial edible film can effectively enhance the shelf life of paneer and also represents a sustainable and consumer-acceptable packaging alternative for dairy products.

Keywords: Antimicrobial packaging, edible packaging, biodegradable packaging, smart packaging, whey protein

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Digital Empowerment or Digital Divide: A Systematic Review of Technology Adoption among Rural Women in Agricultural Entrepreneurship

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The digital transformation of agriculture presents significant potential to enhance entrepreneurial outcomes in rural sectors. This potential, however, remains unequally distributed, particularly for women, who comprise a substantial proportion of the agricultural labor force in developing economies but face persistent digital marginalization. This systematic review synthesizes empirical evidence from 87 peer-reviewed studies published between 2010 and 2024 to critically analyze the determinants and effects of digital technology adoption among rural women engaged in agricultural entrepreneurship. The analysis is situated within a feminist political economy framework, which illuminates how structural and social power dynamics mediate technological access and use. Findings reveal a multifaceted digital gender gap, characterized by disparities in access to technology (evidenced by a 40–60 percent gender gap in smartphone ownership), limitations in digital capability (with 82 percent of studies identifying digital literacy as a primary barrier), and constrained opportunities for meaningful use (65 percent of studies highlighting the restrictive role of social norms). Notably, mere access to technology does not guarantee benefits; the quality of access and autonomy in use are critical determinants of empowerment outcomes. In instances where adoption is successful, studies report substantial positive impacts, including income increases of 25–40 percent, enhanced decision-making autonomy, and improved market linkages facilitated by digital platforms. Collective institutional structures, such as self-help groups and farmer producer organizations, emerge as key facilitators in overcoming contextual barriers. The study concludes that bridging the digital divide requires interventions that move beyond technical solutions to address underlying gender norms and structural inequalities. It advocates for integrated policy and extension strategies that are explicitly gender-transformative to ensure digital technologies contribute equitably to sustainable agricultural development and women's economic empowerment.

Keywords: digital divide, gender analysis, agricultural technology, women's entrepreneurship, rural development, systematic review, feminist political economy.

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Morphological characterization and genetic diversity analysis using SSR markers of local potato accessions

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We aimed to collect native potato germplasm, create allelic profiles and examine molecular diversity of collections from different parts of India. The native accessions were collected from different potato growing regions representing sub-tropical plains (43), north-west hills (26), north-east hills (23), and unknown source (2) in India. Diversity analysis was carried out utilizing the known 14 potato simple sequence repeat (SSR) markers. All SSR markers were polymorphic and showed a significant genetic variety in the genotypes, which are native collections that have been acclimated to the local environment and are widely cultivated throughout the nation. 14 polymorphic SSR loci containing a total of 101 alleles were identified in the collection. Allele sizes per marker ranged from 75 bp (STM0037) to 296 bp (STM5114), however the number of alleles per marker varied from 2 (STI0030) to 13 (both STPoAc58 and STM0031). SSR's polymorphic information content (PIC) was measured between 0.29 (STI0030) to 0.90 (both STPoAc58 and STM0031). The total number of alleles at 14 SSR loci across 94 genotypes was 4536, with the range being individually 36 (NJ-84) to 67 (Nainital). Based on the Jaccard similarity coefficient (0.33-0.85) and the Neighbour-Joining clustering approach, the genotypes were clearly divided into four clusters: cluster I (21 genotypes), cluster II (14 genotypes), cluster III (31 genotypes), and cluster IV (28 genotypes). Principal component analysis (PCA) plot showed genetic relatedness with first and second PCA components as 46.69% and 3.41%, respectively. Our results imply that using these native collections, SSR-based allelic diversity is a valuable resource to support potato breeding studies. To our knowledge, this is the first ever report on the new Indian collection and their molecular (SSR) analysis.

Keywords: Potato, Germplasm, Morphological, SSR markers

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Impact of Sustainable Practices in Weed Management by Integrated Weed Management (IWM)

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Sustainable practices can be achieved by the integrated weed management. Field investigation was conduct the impact of IWM practices by use of herbicides, Hand weeding and mulch on biotic factor, crop growth and yield components of wheat crop in Dehradun (Uttarakhand) India during 2021to 2022. Wheat (Triticum aestivum L.) Crop is staple food in India after the rice. Investigated area wheat was sown in December. RBD design with the nine treatments one hand weeding, pre emergence herbicides, post emergence herbicides, Paddy straw mulch and one plot was unweed accomplished. Treatment used Methsulfuron methyl 20% WP (POE), Pinoxoden 5.1% EC (POE), Pendimethalin 30% EC (PE), Handweeding at (30, 60, 90) DAS, Unweeded, isoproturon 75% WP (PE), Clodinafop 15% WP (POE), 2,4D 58% SL (POE), paddy straw.The germination, plant height and number of tillers at different stages was more in in hand weeded followed by mulch cover filed. Weed flora density was lower at different stage. WCE % was higher and WI% lowest was in hand weeded followed by mulch cover filed. Studies find that the integrated combination of weed control hand weeded followed by mulch cover field was show better performance as the comparison of other tools. Crop growth indices CGR was highest in hand weeded followed by mulch cover field. Crop yield components number of ears/plant, grains/spikelet's, spikelet's/tillers, grain yield and straw yield as compared to the others treatment was higher in the hand weeded and mulch cover field. These studies suggest that IWM is valuable tools for the enhancing sustainable practises for soil health, reduce the herbicide resistance and increase crop production system.

Key words: Paddy straw, weed flora Density, WCE, WI, Tillers, Yield, Pendimethalin, Clodinafop propargyl, spikelet's, sustainable practices

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Biochemical characterization and shelf life evaluation of snake gourd (Trichosanthes cucumeria var. anguina) genotypes.

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The experiment to study the biochemical diversity of twenty-five genotypes of snake gourd (Trichosanthes cucumerina var. anguina) was conducted at the Instructional cum Research Farm, School of Agricultural Sciences, Nagaland University, Medziphema Campus in the year 2022. The experiment was laid out in a randomized block design with three replications. The biochemical composition and shelf life of different genotypes of snake gourd was focused on parameters such as total soluble solids (TSS), Vitamin C, moisture content, carbohydrate, crude protein and dry matter. Considerable variations were observed across the evaluated genotypes which highlighted the genetic diversity available for quality improvement. The TSS ranged from 2.64°Brix (Manushree) to 4.20°Brix (Genotype-1) with mean value of 3.48°Brix which indicated scope for selection of sweeter lines. Vitamin C content was highest in Genotype-16 (5.00 mg $100g^{-1}$) and lowest in Genotype-12 (3.46 mg $100g^{-1}$). Moisture content ranged from 91.06% (Genotype-3) to 94.83% (Genotype-18) which indicated significant differences in textural quality and storability. Carbohydrate content ranged from 2.97% (Konkan Swetha) to 4.67% (Genotype-18) with a mean of 3.53%. Crude protein content was highest in Kaumudi and Genotype-16 (0.69%) and lowest in Genotype-8 (0.40%). Dry matter content varied widely from 5.17% (Genotype-18) to 8.94% (Genotype-3). Shelf life extended from 8.67 days in Manushree and Genotype-9 to 14.67 days in Genotype-16 with a mean value of 11.35 days. Overall, Genotype-16 stood out with superior vitamin C (5.00 mg $100g^{-1}$), higher carbohydrate (4.24%), maximum crude protein (0.69%) and longest shelf life (14.67 days) for both nutritional enhancement and extended storage. Similarly, Genotype-3 and Genotype-1 exhibited higher dry matter and TSS which were found suitability for processing and taste preference.

Keywords: TSS, Vitamin C, Moisture, snake gourd and genotypes

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Use of Remote Sensing and GIS in Site-Specific Nutrient and Water Management.

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Efficient nutrient and water management is critical for achieving sustainable agricultural productivity and environmental protection. Traditional blanket fertilizer and irrigation practices often fail to account for spatial variability within fields, resulting in nutrient losses, low water use efficiency, and reduced crop yields. The integration of Remote Sensing (RS) and Geographic Information Systems (GIS) in site-specific nutrient and water management provides a powerful solution to these challenges. Remote sensing technologies, including satellite imagery, multispectral sensors, and drone-based platforms, allow real-time monitoring of crop health, soil moisture, and nutrient status across heterogeneous fields. GIS enables the mapping, spatial analysis, and visualization of soil fertility gradients, water distribution patterns, and crop nutrient requirements, facilitating precise planning and application of fertilizers and irrigation tailored to crop-specific and location-specific needs. By adopting RS and GIS-based site-specific management, farmers can optimize input use, increase nutrient use efficiency (NUE), improve water productivity, and achieve higher and more stable crop yields. Additionally, this approach helps mitigate environmental risks such as nutrient leaching, surface runoff, groundwater contamination, and greenhouse gas emissions. The integration of RS and GIS also supports decision-making under climate variability, allowing adaptive management practices for resilient and sustainable agriculture. Overall, RS and GIS technologies represent a transformative advancement in precision agriculture, enabling resource-efficient, environmentally sustainable, and economically viable farming systems for the future.

Key words: Precision Agriculture, Nutrient Use Efficiency, Precision Irrigation, Remote Sensing

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INTERNATIONAL TRADE

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Key regulatory bodies in India involved in agricultural exports include DGFT (Directorate General of Foreign Trade), APEDA (Agricultural and Processed Food Products Export Development Authority), FSSAI (Food Safety and Standards Authority of India), and NPPO (National Plant Protection Organization). Essential export documents include the Proforma Invoice, Purchase Order, Letter of Credit, Quality Certificate, Packing List, Weight Certificate, and Certificate of Origin. Trade is a fundamental component of global economic activity, broadly categorized into domestic and international trade. International trade involves the exchange of goods, services, and capital across national borders and is characterized by complexities such as foreign currencies, customs regulations, and trade barriers. For example, the export of basmati rice from India to the UAE illustrates agricultural international trade. Key global institutions like the WTO and IMF define it as the cross-border exchange of goods and services governed by national regulations. Critical steps in engaging in international agricultural trade include product and market identification, exporter registration (IEC code), quality certification, pricing and negotiation, pre- shipment inspection, customs clearance, and logistics. Market research plays a key role, focusing on global demand for commodities such as rice, spices, tea, fruits, and vegetables, as well as niche markets like organic produce and products with Geographical Indication (GI) tags. This review highlights the essential processes, regulatory frameworks, and market dynamics involved in Indias agricultural international trade.

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Dhaincha (Sesbania bispinosa): A Valuable Resource for Agriculture and Industry

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Dhaincha (Sesbania aculeata / Sesbania bispinosa), an annual herb or shrub of the Fabaceae family native to South Asia and Africa, is primarily cultivated as a green manure crop due to its nitrogen-fixing ability that improves soil fertility. In addition to its agricultural importance, it is also utilized as fodder, fuelwood, and for industrial purposes such as gum, paper, textiles, and oil production. Dhaincha plays a key role in sustainable agricultural systems, including intercropping, agroforestry, and conservation tillage, where it aids in weed suppression, microclimate regulation, and soil erosion control. Despite these benefits, the crop is susceptible to viral diseases like Pedilanthus Leaf Curl Virus (PeLCV), Sesbania Stem Mosaic (SSM), and Sesbania Mottle Mosaic (SMM), as well as seed-borne fungal pathogens such as Aspergillus, Fusarium, Rhizopus, and Penicillium spp., which adversely affect seed quality and germination. Commercially, it is valued for gum production, as the seed endosperm serves as a rich source of natural polymer, which after processing yields a fine, milky-white powder with diverse industrial applications. Overall, Dhaincha represents a sustainable and cost-effective crop that enhances soil health, supports livestock feeding, and contributes to climate resilience, demonstrating the successful integration of traditional practices with modern agricultural approaches.

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Global Climate Change on Agricultural Production

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Global warming is one of the greatest threats to the social development of human beings and Animals. It is a typical example of global climate change, and has profoundly affected human production and life in various aspects. As the foundation of human existence, agricultural production is particularly vulnerable to climate change, which has altered environmental factors such as temperature, precipitation and wind speed affected crop growth cycles, the frequency of extreme weather events, and the occurrence patterns of pests and diseases directly or indirectly, ultimately influencing crop yield and quality. Climate warming has led to a general reduction in the growing period of crops, accompanied by increased temperature fluctuations, which may result in inadequate nutrient accumulation in crops. Crop growth cycles are also influenced by changes in sunshine hours, and reduced sunlight will restrict crop growth. Furthermore, climate change can affect the flowering and grain-filling periods of crops, resulting in varying degrees of frost damage and drought. Minoli, S. et al. investigated the effects of climate change on crop growth cycles and the importance of adaptive management strategies through adjustments in planting dates and varieties from a global perspective.

Keywords: Global climate change, agricultural production, direct impact, indirect impact.

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Effect of Climate Change on Poultry Production and Mitigation Strategies in India

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Poultry farming is one of the most efficient animal husbandry practice and it provides nutritional security to a significant number of the world population. Chickens, reared for rapid growth and high meat production on optimal environmental conditions to achieve their genetic potential. However, climate change disrupts these conditions and poses numerous challenges for poultry production. One of the primary impacts of climate change on poultry production is the decreased ability of birds to attain their genetic potential for faster growth. However, in tropical climates affected by climate change, the consequent rise in daily temperatures, increased humidity and altered precipitation patterns create an unfavorable environment for poultry. These conditions impede their growth and development, preventing them from reaching their maximum genetic influence, which is crucial for achieving desirable production outcomes. Furthermore, climate change exacerbates the existing challenges faced by poultry production systems. Higher feed costs impact the industry economic viability and limit the availability of quality nutrition for the birds, further hampering their growth potential. In addition to feed scarcity, climate change also predisposes chickens to thermal stress. This review collates existing information on climate change and its impact on poultry production, including nutrition, immune function, health and disease susceptibility. It also summarizes the challenges of poultry production under hot and humid climate conditions with different approaches to ameliorating the effects of harsh climatic conditions in poultry.

Key words- Poultry, Tropical climates, Meat, Production, Nutrition, Health, Disease

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Optimization of Seed Production Technology of Cucumber (*Cucumis sativus* L.) *cv*. Pusa Parthenocarpic Cucumber-6 under Naturally Ventilated Polyhouse Condition

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Dr. Balraj Singh** (Major Advisor)

To mitigate the critical issue of increased under developed or unfilled seeds during cucumber quality seed production, the present investigation entitled "**Optimization of Seed Production Technology of Cucumber (*Cucumis sativus* L.) *cv*. Pusa Parthenocarpic Cucumber-6 under Naturally Ventilated Polyhouse Condition**" was conducted during *Kharif* season-2023 & summer season-2024 under naturally ventilated polyhouse condition of Department of Horticulture, S.K.N. College of Agriculture, Jobner (Jaipur) under SKNAU, Jobner. The targeted objectives were identification of suitable chemical and its dose for induction of staminate flowers, pollination time for fruit set, fruit load regulation and to determine the effect of harvesting stages & post-harvest ripening on seed yield and quality. Three chemicals *viz.* gibberellic acid (500 & 1000 ppm), silver nitrate (300 & 500 ppm) and silver thiosulphate (300 & 500 ppm) were used and total seven treatments including control were applied as foliar applications on parthenocarpic cucumber *cv*. 'Pusa Parthenocarpic Cucumber-6 (PPC-6) in experiment no.-1. In second experiment flowers were further pollinated at 7, 8, 9, 10 and 11 AM and in third experiment retention of one, two, three, four and all fruits per vine and further in fourth experiment harvesting at 25, 35 and 45 days after anthesis and post-harvest ripened for 0, 10, 20 and 30 days for standardization of above four quality seed production.

Among the three chemicals, silver thiosulphate @ 300 ppm exhibited superior results for days taken to appearance of first staminate flower, node on which first staminate flower appeared, node number up to which staminate flower appeared, total number nodes induced staminate flower and number of staminate flower over other treatments except flower diameter which was found to increase with silver nitrate @ 500 ppm. All the seven treatments were found to produce staminate flower, except control.

Further pollination at 9 AM conferred superior results as it had maximum percentage of fruit setting (90.91 %), percentage of fruits to develop physiological maturity (74.93 %), seed setting percentage (81.43 %), number of filled seeds (231.29), total number of seeds per fruit (283.59), seed yield (34.76 g) and 50-seed weight (1.44 g) and reduced number of unfilled seeds per fruit (52.30) in PPC-6 cultivar. Similarly, maximum net returns (1892173 ₹/500 m^2) and ICBR (10.65) were obtained with the same treatment. Retention of three fruits per plant may be recommended for practice as it provided higher seed yield without compromising seed quality. Further, significantly higher net returns of (1408333 ₹/500 m^2) and ICBR (7.93) were fetched when retention of three fruits per plant. To obtain optimum seed yield with better seed quality, the fruits should be harvested and subjected to post-harvest ripening, either on 45 DFP+30-days PHR under naturally ventilated polyhouse condition.

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DECHLORINATION AND DEFLUORIDATION OF TREATED SEWAGE WATER AND ITS INFLUENCE ON SOIL PROPERTIES, GROWTH AND YIELD OF FRENCH BEAN (*Phaseolus vulgaris* L.)

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An experiment was conducted in College of Sericulture, Chintamani to study dechlorination and defluoridation of treated sewage water, its influence on soil properties, growth and yield of French bean. Dechlorination and defluoridation of treated sewage water was done by using different locally available amendments like alum, activated alumina, charcoal, biochar, calcium sulphate, calcium carbonate, calcium silicate. Activated alumina, alum, charcoal and biochar significantly reduced the chloride (3.32, 3.50, 3.80 and 3.85 meq L^{-1}) and fluoride content (2.95, 2.90, 3.00 and 3.02 mg kg^{-1}). Irrigation with dechlorinated and defluoridated water on French bean helped in better growth and yield (1.65 kg pot^{-1}) and nutrient status as compared to the irrigation with treated sewage water (1.41 kg pot^{-1}) and irrigation with groundwater (1.29 kg pot^{-1}). Since charcoal and biochar are low cost materials, it was recommended for dechlorination and defluoridation to reduce the chloride and fluoride content, increase the nutrient availability and better crop yield. B:C ratio was found to be 5.07 and 5.02 as compared to the irrigation with groundwater (4.15).

Key words: Dechlorination, defluordidation, alum, activated alumina, charcoal, biochar, calcium sulphate, calcium carbonate and calcium silicate

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Remote sensing: Its applications in Agriculture

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Earth observations (EO), comprising satellite, aerial, and in situ systems, are increasingly recognized as critical tool for studying and monitoring of natural resources and unfolding the intricate behavior of the complex earth's dynamic processes. The Remote Sensing research has evolved as multidisciplinary theme dedicated to developing the applications of remote sensing technology of Land Ocean and atmosphere addressing geologic, botanic, and hydrologic issues at national, regional, and site-specific scales. Agriculture plays dominant role in economy of almost every nation. Whether agriculture represents a substantial trading industry for an economically strong country or simply sustenance for a hungry, overpopulated one, it plays a significant role in almost every nation. The production of food is important to everyone and producing food in a cost-effective manner is the goal of every farmer, large-scale farm manager and regional agricultural agency. A farmer needs to be informed to be efficient, and that includes having the knowledge and information products to forge a viable strategy for farming operations. These tools will help him understand the health of his crop, extent of infestation or stress damage, or potential yield and soil conditions. Commodity brokers are also very interested in how well farms are producing, as yield (both quantity and quality) estimates for all products control price and worldwide trading. The policy makers are interested in harnessing the best available tools for optimizing the resource use, minimizing the damage/losses and ensuring the societal benefit. Most important component of such decisions is the agricultural and allied information at best possible resolution of spatial and temporal scales.

Key Words: Remote sensing, Land, Agriculture and farmer.

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Unravelling Molecular Mechanisms of Rice Root Knot Nematode Resistance in Phule Radha through Transcriptomic Analysis

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Direct-seeded rice (DSR) is emerging as a preferred cultivation method among farmers due to its advantages in conserving resources by eliminating puddling and transplanting steps. However, this system faces key challenges, particularly in weed control, nutrient management (notably iron), and managing rice root knot nematodes (RRKN), which cause significant yield reductions. Chemical control of RRKN is neither efficient nor environmentally safe, making genetic resistance a sustainable and practical alternative. The present study aimed to explore the transcriptomic basis of RRKN resistance using RNA sequencing (RNA-seq). Two contrasting genotypes, the susceptible *Pusa Basmati 1121* (PB1121) and the resistant *Phule Radha*, along with resistant and susceptible bulks from recombinant inbred lines (RILs), were analyzed to identify differentially expressed genes (DEGs) involved in resistance. In PB1121, several DEGs were associated with defense mechanisms, photosynthesis, ATP-linked electron transport, and diterpene phytoalexin biosynthesis. Despite activating defense responses, PB1121 remained vulnerable due to RRKN manipulation of host metabolic processes for its own benefit, as shown by the upregulation of photosynthesis- and respiration-related genes. In contrast, Phule Radha exhibited a robust transcriptional response, with DEGs related to defense, hormone signaling (ethylene, jasmonic acid, and salicylic acid), and secondary metabolite biosynthesis being significantly upregulated. A total of 49 DEGs (23 upregulated and 26 downregulated) were consistently identified in both the resistant parent and resistant bulk, representing promising candidates for RRKN resistance. Notably, pathways linked to hormonal signaling, MYB and WRKY transcription factors were activated, while components of ethylene signaling and proteolysis pathways were repressed. These findings suggest that Phule Radha employs a multifaceted defense mechanism and may serve as a valuable genetic resource for breeding RRKN-resistant rice varieties.

Keywords: RNA Seq, Differentially Expressed Genes, Recombinant inbred lines.

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Solar-Powered Hydroponics: Leafy Greens in Layers for Sustainable Urban Farming

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Vertical farming is transforming the way cities grow food. Instead of using large fields, crops are grown in stacked layers, making the most of limited urban space. Using hydroponics and aeroponics, vertical farms can produce much more food per square meter than traditional farms. According to the IMSEAR report, these systems use up to 80% less water, helping save precious urban water resources. The World Health Organization (WHO) notes that hydroponic farming can improve food security and provide fresh, nutritious produce where land is scarce. Renewable energy and automation, such as smart lighting and climate control, make vertical farms energy-efficient and eco-friendly, reducing the carbon footprint of food production. In India, the Indian Council of Agricultural Research (ICAR) has promoted innovative projects like the "Women Friendly Multipurpose Integrated Vertical Nutri-Farming System," combining vegetable growing, mushroom cultivation, and poultry farming to provide diverse nutrition and help families adapt to climate changes. Our work focuses on establishing a small-scale hydroponic vertical farm to study water use efficiency, crop yield, and growth of leafy vegetables like spinach and lettuce. The system uses nutrient-rich water, LED lighting, and automated timers to maintain optimal conditions. We monitor water consumption, plant growth, and nutrient levels to demonstrate how vertical farming can produce more food with less water and space. The pilot also explores solar-powered lighting to reduce energy use and carbon footprint. This hands-on study highlights vertical farming as a practical, sustainable solution for urban food security and resilient food systems.

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Climate Change in the Himalayas: Assessing the Impact in Uttarakhand

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Climate change poses a major threat to the ecosystems of the Indian Himalayan region, with Uttarakhand among the most severely affected states. Known as the *"Water Tower of Asia,"* the Himalayas hold the world's third-largest concentration of ice after the Arctic and Antarctic, accounting for nearly 14% of global reserves. These glaciers feed major river basins that provide freshwater to millions across South Asia. Uttarakhand has experienced a rising frequency of climate-induced disasters, with floods being the most destructive. The 2013 Kedarnath flood exemplifies the scale of devastation, causing massive loss of lives, infrastructure, and agricultural assets. Environmental degradation, particularly deforestation, has intensified landslides, soil erosion, and loss of fertility, further threatening agriculture—the region's primary livelihood. Farmers frequently face declining yields, land loss, and irregular rainfall, leading to recurrent economic setbacks. Addressing these challenges requires strong policy action. Priorities include disaster-resilient infrastructure, ecological restoration, robust early warning systems, sustainable tourism, and stricter regulation of construction in fragile zones. Promoting community-cantered adaptation, supported by effective governance, is vital to safeguard livelihoods and enhance long-term resilience. This review emphasizes the urgent need for sustainable strategies to confront climate challenges in the ecologically sensitive Himalayas. Immediate, coordinated action by governments, policymakers, and local communities is critical to protect fragile ecosystems and secure the survival of mountain populations

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A detailed insight into the foraging patterns of different *Megachile* bees in sesame agroecosystem in Eastern India

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Bee-mediated pollination is pivotal for optimizing yield and seed quality in sesame, a predominantly self-pollinated crop that demonstrates enhanced productivity through insect visitation. Despite the well-known benefits of bee pollination in sesame, detailed insights into the role of solitary bees, particularly *Megachile* spp., remain limited. This study addresses this knowledge gap by systematically evaluating the diversity, relative abundance, and foraging behaviour of *Megachile* bees in sesame agroecosystems over two consecutive pre-*Kharif* seasons (2022–2023) in West Bengal, India. A total of 39 insect species were documented, with Hymenoptera being the most dominant order (61.54%). Within this group, *Apis dorsata*, *Ceratina smaragdula*, and *Apis zonata* from the Apidae family, and *Megachile disjuncta*, *M. umbripennis*, and *M. conjuncta* from Megachilidae emerged as principal pollinators. Diurnal foraging patterns revealed peak activity during early morning and mid-morning hours, with *A. dorsata* and *M. umbripennis* showing consistent visitation across both years. Among *Megachile* bees, *M. lerma* displayed the highest foraging rate and speed, particularly during midday hours, suggesting superior adaptability to thermal conditions. In contrast, *M. disjuncta* exhibited slower, more deliberate foraging behaviour, likely linked to nectar abundance and interspecific energy strategies. This study provides the first comprehensive account of *Megachile* bee activity in sesame fields in this region, revealing their crucial role in pollination ecology and seed set. The findings emphasize the need for targeted conservation of *Megachile* habitats and the integration of solitary bee management into sesame cultivation practices. The results offer novel insights into solitary bee contributions to crop pollination, supporting sustainable agriculture and biodiversity conservation.

Keywords: *Megachile* bees, sesame, pollination ecology, foraging pattern, agroecosystem, biodiversity conservation

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Smart and Sustainable Food Packaging Technologies in FMCG Sector

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Food packaging is historically framed by four essential functions: protection, communication, convenience and containment have entered a new phase shaped by sustainability imperatives, rapid technological progress, and shifting consumer expectations. This review synthesizes the field across three axes: (i) classical roles and their continued relevance; (ii) the environmental drivers compelling systemic change, including marine and terrestrial plastic pollution and micro plastic exposure; and (iii) emerging innovations in intelligent (smart) and active packaging, as well as edible, recyclable, biodegradable, and minimalist solutions. We critically discuss challenges and limitations including e-waste from embedded electronics, technical robustness, cost and scale barriers for bio-based materials, consumer acceptance, regulatory fragmentation, and sustainability trade-off and outline future directions such as green electronics, inclusive interfaces (digital displays and voice assistance) and IoT/AI enabled traceability aligned with circular economy models. Collectively, these developments are propelling packaging from a passive container toward a digitally connected, environmentally responsive system that enhances safety, reduces waste, and empowers consumers and supply chains.

Keywords: *Food packaging, Sustainable packaging, Intelligent (smart) packaging, Active packaging, Biodegradable materials, Circular economy, IoT/AI.*

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Diverse roles of women working in the Agricultural Sector for Empowerment

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Empowerment in the context of women's development is a way of defining, challenging and overcoming barriers in a woman's life through which she increases her ability to hope her life and environment. It is an active, multidimensional process which should enable women to realise their full identity and power in all spheres of life. Since time immemorial, women have played, and continue to play, a key role in conservation of basic life support system, such as, land, water, flora and fauna. Rural women play a crucial role in agricultural development and allied fields, including crop production, livestock production, horticulture, post-harvest operations, fisheries, etc without total intellectual and physical participation of women, it is not possible to achieve the goals of rural uplift.

In spite of all this, it is unfortunate that because of centuries of inertia, ignorance and conservatism, the actual and potential role of women in the society has been ignored, preventing them from making their rightful contribution to social progress. It is also because of distorted and/or partial information about their involvement in agriculture and consequent devaluation of their contribution that they are denied their rightful status as active producers in agriculture and access to developmental resources and services contributing to their marginalisation. **Women must be empowered by enhancing their awareness, knowledge, skills and technology use efficiency so that agricultural production multiplies at a faster pace**, environmental degradation is reduced and conservation of resources is practised earnestly, thereby, facilitating overall development of the society.

All this signifies the importance of having a full understanding of the role and contribution of farm women so that the extension services may accordingly be devised and geared to fully integrate them in agriculture by better serving their specific needs and interests. It is the concern for their integration in the process of agricultural development. Real rural development cannot be taken place unless the rural women does not empowered properly with the latest knowledge and technologies. Gaon Badhe to desh badhe cannot be fulfilled with the

empowerment of rural womens with improved machinery and latest technologies. **Krishi Vigyan Kendras** a conceptual grass root level organizations meant for fulfilment of these in each and every district of the country under the flagship of Indian council of Agricultural Research. These Farm Science Canters are now working as **Knowledge Bank** for all round development of the districts and providing the location specific technologies also, for drudgery reduction of farm womens.

Women have to do jobs that are time and labour intensive such as sowing, transplanting, weeding, intercultural, harvesting, threshing, and post-harvest operations like, shelling, cleaning, grading and processing. They also contribute to decision-making processes for crop production, seed production and management, post-harvest management of agricultural and horticultural produce, biomass utilisation, livestock management, marketing and financial management. In addition, women take up small ventures to generate additional family income. Therefore, the role of women in agriculture and allied occupations, and a household activity needs proper recognition. Women constitute a major component of agricultural workforce. They have, however, lagged behind in use of improved crop production and processing tools and machinery.

Now, a number of gender neutral and simple devices/equipment for crop production and processing has been developed. Their adoption by women will not only help improving agricultural production but will also elevate the status of women through better jobs and greater role in the economy of the family as well as nation. In addition to their role in agricultural production, women are gainfully employed in agri-based allied activities like dairying, animal husbandry, poultry, goatery, rabbit rearing, beekeeping, floriculture, horticulture, fruit preservation, post-harvest technology, value-added food products, etc.

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IOT DRIVEN ROOT ENVIRONMENT MONITORING SYSTEM-HYDROPONICS

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In hydroponic farming, maintaining optimal root zone conditions—such as pH, temperature, humidity, salinity, dissolved oxygen, and nutrient concentration—is essential for plant health and productivity. While existing systems can monitor these parameters, they often lack the capability to interpret how subtle fluctuations collectively contribute to root stress, a condition that can lead to diseases like root rot and significant yield loss if not addressed promptly. Our project focuses on developing an IoT-driven root stress monitoring system that goes beyond individual sensor readings. By continuously tracking key root zone parameters and analyzing their variations in real time, the system aims to identify early signs of root stress before they become visible or harmful. This allows for immediate alerts and timely interventions, minimizing crop loss and ensuring stable growing conditions. By making root stress visible and manageable, our project brings smart, data-driven decision-making into everyday farming. It reduces manual effort, prevents root-related diseases, and improves crop productivity—offering a scalable and affordable solution for small and medium-scale hydroponic growers

Key words: IoT (Internet of Things), Root environment monitoring, Hydroponics, Soilless cultivation, Sensors – temperature, humidity, pH, EC (electrical conductivity),Real-time data, Microcontroller / Microprocessor, Wireless communication – Wi-Fi, Bluetooth, Automation, Data logging, Mobile application / Web dashboard, Nutrient solution management, Water quality monitoring, Energy efficiency, Precision agriculture, Cloud storage / Cloud computing Decision support system, Sustainable farming, Crop yield optimization, Smart farming.

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Effect of GA_3 and silver compounds on staminate flower induction in gynoecious parthenocarpic cucumber under naturally ventilated polyhouse condition

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Cucumber (Cucumis sativus L.) is a predominantly cross-pollinated self-fertile species characterized by diverse floral morphologies, including staminate, pistillate, and hermaphroditic flowers, which generally develop singly at each node. The determination and differentiation of floral sex in cucumber are profoundly regulated by exogenous application of plant growth regulators, which can alter floral architecture and sex expression. Gynoecious parthenocarpic cucumber lines, which are highly advantageous for off-season production due to their exclusive female flowering habit and seedless fruit development, naturally lack staminate flowers. Therefore, the exogenous induction of male flowers through hormonal treatments becomes imperative for effective line maintenance and seed propagation in breeding programs. A study conducted under Naturally Ventilated Polyhouse Condition" during Kharif season of 2023 and Summer season of 2024 in the naturally ventilated polyhouse of Department of Horticulture, S.K.N. College of Agriculture, Jobner (Jaipur) with aimed to manipulate the sex expression in the gynoecious parthenocarpic cucumber variety 'PPC-6' using a Randomized Block Design (RBD) with three replications. Three different chemicals viz., Gibberellic acid (GA3) @ 500 and 1000 ppm, silver nitrate (Ag NO3) and silver thiosulphate (Ag2S2O3) @ 300 and 500 ppm were sprayed at 2-4 leaf stage at 7 days interval till the 10-12 leaf stage whereas, control was sprayed with distilled water only. Among the three chemicals, silver thiosulphate @ 300 ppm exhibited superior results for days taken to first staminate flowering (28.45 days), lowest node on which first staminate flower initiated (4.52), highest node number up to which staminate flower appeared (23.61), induced maximum staminate flowering nodes (19.09) and maximum number of staminate flowers per plant (134.28) was recorded under treatment MG5 (Ag2S2O3 @ 300 ppm) while, MG4 (AgNO3) was superior over other treatments in terms of diameter of staminate flower (5.30 cm). All the seven treatments were found to produce staminate flower, except control.

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Physiological response of 24-epibrassinolide (24-EBL) and salicylic acid (SA) in wheat (*Triticum aestivum* L.) under salinity stress

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Wheat (*Triticum aestivum* L.) is the second major cereal crop extensively cultivated in India after rice, which is contributing a pivotal role in the national food and nutritional security. Nearly 40% percent of the global burgeoning population relies on the wheat crop for about 20% of daily caloric intake. Salinity stress is one of the major devastating abiotic stresses which results in significant damages of agricultural production, particularly in arid and semi-arid regions of the world. Seed priming with plant growth regulators is one of promising approaches to improve crop productivity under salinity stress conditions. In this current investigation, three individual experiments were designed to achieve three different objectives. The first experiment aimed to identify the optimum seed priming concentration of 24-Epibrassinolide (24-EBL) and Salicylic acid (SA) in wheat under salinity conditions. Seeds of two wheat genotypes (WH 1270 and KRL 210) were soaked in various concentrations of 24-EBL and SA ranging from 0.25-1.25 µM and 25–100 ppm respectively, for 12 hrs priming duration. These seeds grown in paper towel method under three different salinity levels (5, 7.5 and 10 dS m^{-1}) along with control (Double distilled water) for about 15 DAS. The findings revealed that increased root length, shoot length, fresh weight and dry weight of seedlings observed @ 0.50 µM of 24-EBL and 100 ppm of SA. Seed priming treatment for 12hr duration showed significant positive influence on germination percentage and seedling growth traits compared to unstressed treatment (control). After that second experiment aimed to evaluate the physiological role of 24-EBL and SA at seedling stage in wheat varieties under hydroponic salinity. The observations recorded at 21 DAS shown that, comparatively KRL 210 shown prominent response to 0.50 µM of 24-EBL and 100 ppm of SA than WH 1270 in different hydroponic salinity levels compared to control. Similarly, the third experiment aimed to evaluate the physiological role of 24-EBL and SA in wheat under soil salinity. These seeds were cultivated in experimental pots under three different soil salinity levels (5 dS m^{-1}, 7.5 dS m^{-1} and 10 dS m^{-1}) along with a control. Morpho-physiological and biochemical parameters recorded at 60, 90 and 110 days after sowing (DAS) to evaluate the positive effect of 24-EBL and SA. The findings of this study revealed that enhancement in Morpho-physiological, biochemical and yield components observed @ 0.50 µM of 24-EBL and 100 ppm of SA in both genotypes. Comparatively KRL 210 shown prominent response to seed priming treatments than WH 1270 in different soil salinity levels compared to control.

Key Words: Abiotic stress, 24-Epibrassinolide (24-EBL), Hydroponics, Salicylic acid (SA), Salinity stress, Seed priming and Wheat.

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Pulse-cereal intercropping: enhancing soil health and crop productivity in arid regions

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Intercropping, a practice of growing two or more crops simultaneously, has gained significance in production-oriented agriculture due to its potential for efficient resource utilization and enhanced crop productivity. This review explores the effects of intercropping on growth parameters, particularly in pulse-based intercropping systems with cereals. The complementary growth behaviors and input requirements of pulses and cereals lead to efficient use of resources, increased productivity, and improved soil health through biological nitrogen fixation. Intercropping also enhances nutrient, moisture, and light efficiencies, and provides better pest control. However, studies have shown that intercropping can decrease plant height, tiller number, leaf area index, and crop growth rate in pearl millet compared to sole cropping. The concepts of intercropping have evolved from a risk-covering practice in traditional agriculture to a means of efficient resource utilization in production-oriented agriculture. The advantages of intercropping include yield stability, better use of growth resources, weed and pest control, erosion control, and improved soil fertility. Pearl millet, a climate-resilient crop, is well-suited for arid and semi-arid regions characterized by low rainfall, high temperatures, and poor soil fertility. Its deep root system, high photosynthetic efficiency, and C4 metabolic machinery enable it to thrive in these challenging environments, making it an important crop in dryland agriculture.

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Studies on varietal preference of exotic whitefly complex Rugose spiralling whitefly, *Aleurodicus rugioperculatas* Martin and Bondar's nesting whitefly *Paraleyrodes bondari* Peracchi in coconut (*Cocos nucifera* L.) and its eco-friendly management

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Studies on varietal preference of exotic whitefly complex Rugose spiralling whitefly, *Aleurodicus rugioperculatas* Martin and Bondar's nesting whitefly *Paraleyrodes bondari* Peracchi in coconut (*Cocos nucifera* L.) and its eco-friendly management revealed that highest incidence of 87.53 % and intensity of 92.79 % was recorded highest in Gauthami Ganga (dwarf), while Kera Bastar (tall) recored lowest incidence of 51.11 % and intensity of 69.20 %. RSW population stages were found to be dominant when compared to BNW in all the cultivars. Percent RSW pupal parasitation by *E. gaudeloupae* was highest in Gauthami Ganga as compared to other cultivars and nill parasitazation of BNW pupae by E. gaudeloupae was observed. In the experimental block selected for spraying low, medium and high grade of RSW and medium and high grades of BNW were observed. Under low grade of whitefly complex (RSW) entomopathogen *Isaria fumosorosea* NBAIR pfu-5 @ 5ml/L was found to be effective in reducing the incidence from 28.75 to 5.90 % and intensity from 25.12 to 5.20 % while in medium grade the incidence reduced from 44.78 to 22.09 % and intensity reduced from 48.80 % to 25.25 %, whereas in high grade plantation block there was no impact of sprayings on population of whitefly complex. Functional response and density dependent feeding interaction of *A. astur* to different densities of eggs, nymph, pupa and adults of both RSW and BNW revealed, a type II functional response with third instar of *A. astur* been the most effective stage.

Key words: incidence, intensity, entamopathogen, *A.astur*

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Biophysical, Biochemical screening of guava varieties against Fruitborer , (*Conogethes punctiferalis*) in guava

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Among the different varieties screened highest infestation by *C. punctiferalis* was recorded in Taiwan pink (42.50%) and Taiwan white (40.00 %) followed by Allahabad Safeda (22.25 %), Lucknow 49 (28.50 %) and Lalith (18.30 %). Biophysical traits of guava fruits significantly influenced infestation by fruit borer, *Conogethes punctiferalis*. Fruit length (0.805*), fruit breadth (0.977**), fruit weight (0.987*) were significantly positively correlated whereas, fruit firmness (-0.925**) and rind thickness (-0.90** cm) were significantly and negatively correlated with infestation percentage. Biochemical analysis showed that total sugars (0.916**), reducing sugars (0.924**), non-reducing sugars (0.925**), moisture content (0.911**) and total soluble solids (0.202**) were significantly positively correlated whereas, total phenols (-0.970**), vitamin C (-0.915*), pectin content (-0.970**) and titratable acidity (0.960**) were significantly negatively correlated with fruit infestation. Secondary metabolites such as myristic acid (0.950**), palmitic acid (-0.980**), oleic acid (-0.937**) and β-caryophyllene (-0.981**), gallic acid (-0.926**), ellagic acid (-0.963**), rutin (-0.989**), quercetin (0.973**) and kaempferol (-0.963**) significantly negatively correlated with fruit infestation.

Key words: Guava, biophysical, biochemical, secondary metabolites

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Studies on seasonal incidence of Rugose spiralling whitefly (*Aleurodicus rugioperculatus*) and fruitfly (*Bactrocera dorsalis*) in guava in relation to abiotic and biotic factors

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An experiment was conducted to know the seasonal incidence of Rugose spiralling whitefly, *Aleurodicus rugioperculatus* and fruitfly, *Bactrocera dorsalis* during 2023-2024 (October - April). The pest population of RSW (*A. rugioperculatus*) was observed in 41 SMW with 10.00 population/ leaf and increased to 52.89 population/ leaf at 9 SMW. The mean population of predators (coccinellids, spiders, neuropterans) showed a steady increase from early crop stages to peak infestation period. The overall mean predator population was highest at 9 SMW with 7.20 predators/ plant. Parasitisation by *Encarsia guadeloupae* on RSW was substantial and increased progressively with pest buildup, reaching higher levels during 6 SMW with 34.60 % parasitization. RSW population was significantly negatively correlated with maximum temperature (-0.493*) and minimum temperature (-0.852**), significantly positively correlated with RH I (0.608*) and non- significantly positively correlated with RH II (0.068 NS), significantly negatively correlated with rainfall (-0.568*), significantly positively correlated with predator (0.783*) and parasitoid population (0.742*). The number of fruitfly adults per trap was highest during 12 SMW with 436.00 coinciding with fruit ripening and harvesting period. The pest was parasitized by *Tetrastichus israeli* (7.30 %) at fruit ripening stage).Correlation of fruitfly adults was significantly positively correlated with maximum temperature (0.594**), non- significantly positively correlated minimum temperature (0.088 NS) and RH I (0.211 NS), significantly negatively correlated with RH II (-0.824**), non-significantly negatively correlated with rainfall (-0.203 NS) and significantly positively correlated with parasitoid population (0.870*).

Key words: *Aleurodicus rugioperculatus*, *Bactrocera dorsalis*, seasonal incidence.

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TRANSGENIC TECHNOLOGY IN HORTICULTURAL CROP IMPROVEMENT

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Transgenic technology has emerged as a powerful tool for the genetic improvement of horticultural crops, offering precise and efficient solutions to challenges that are difficult to address through conventional breeding alone. Horticultural crops, including fruits, vegetables, ornamentals, and plantation crops, are often constrained by long juvenile periods, complex reproductive biology, narrow genetic bases, and high susceptibility to biotic and abiotic stresses. Transgenic approaches enable the direct introduction of specific genes across species barriers, thereby accelerating trait development and enhancing crop performance. The application of transgenic technology has significantly contributed to improved resistance against insect pests, diseases caused by viruses, bacteria, and fungi, and tolerance to abiotic stresses such as drought, salinity, heat, and cold. In addition to stress resistance, transgenic interventions have been successfully employed to enhance nutritional quality, shelf life, processing attributes, and aesthetic traits in horticultural crops. Examples include delayed fruit ripening, improved antioxidant content, and modified flower color and vase life in ornamentals. Transgenic crops also support sustainable horticulture by reducing dependence on chemical pesticides, lowering production costs, and minimizing environmental contamination. When integrated with precision agriculture and protected cultivation, transgenic varieties can further enhance input use efficiency and climate resilience. Advances in gene discovery, promoter engineering, and transformation techniques have expanded the scope and precision of transgenic applications in a wide range of horticultural species. Despite their proven potential, the deployment of transgenic horticultural crops faces challenges related to biosafety assessment, regulatory frameworks, public perception, and market acceptance. Addressing these concerns through transparent risk assessment, science-based regulations, and effective communication is essential for wider adoption. Overall, transgenic technology represents a significant innovation in horticultural crop improvement, contributing to sustainable productivity, quality enhancement, and resilience under changing environmental conditions.

Keywords: Transgenic technology; Horticultural crops; Genetic improvement; Biotic and abiotic stress tolerance; Sustainable agriculture

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Integrated effect of inorganic nutrients, biostimulants along with bioagents and botanical extracts against thrips and purple blotch of garlic (*Allium sativum* L.)

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Garlic (*Allium sativum* L.) one of the most widely cultivated *Allium* species after onion, a member of the Alliaceae family. In order to evaluate the effectiveness of biorational and chemical treatments against thrips and blotch in garlic, two consecutive years of field experiments were carried out at the Medicinal and Aromatic Plant Research Station, Rajendranagar, Hyderabad-SKLTGHU, during *Rabi* season 2022–2023 and 2023–2024. The experiments used a contrast factorial randomized block design with ten treatments and three replications. The current study's findings shows that the use of plant-based botanical extracts, in addition to conventional pesticides, is crucial for managing thrips population dynamics. In a similar vein, liquid spraying of biological control agents is essential for reducing the occurrence of disease. The control plot in this investigation had the lowest thrips population (3.10/plant) and thrips infestation (3.55%) after receiving the chemical pesticide Imidacloprid @ 0.3 ml/l. When it came to disease control, however, the situation was different. Specifically, the combination treatments of 50% NPK+ Humic acid at 5 ml/l with *Trichoderma viride* 10 ml/l along with neem oil @ 0.5% demonstrated the highest efficacy in controlling the disease infestation (1.88/plot) and incidence (2.34%), while the chemical treatment proved least effective in controlling the disease infestation and incidence. While other combinations performed mediocrely, complementary evaluations of bioformulation treatments revealed that neem oil spray is the most effective in lowering the prevalence of thrips. By reducing reliance on chemicals, *Trichoderma* and neem oil's excellent performance demonstrates the possibility of environmentally benign and sustainable garlic farming.

KEYWORDS: Blotch, imidacloprid, neem oil, oil extracts, *Trichoderma*

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PRECISION AGRICULTURE AND DIGITAL INNOVATIONS FOR CLIMATE ADAPTATION

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Climate change poses significant challenges to agricultural and horticultural production systems through increased temperature variability, erratic rainfall patterns, frequent extreme weather events, and heightened biotic and abiotic stresses. Precision agriculture and digital innovations have emerged as transformative approaches to enhance climate adaptation and resilience by enabling data-driven, site-specific, and resource-efficient crop management. This chapter explores the role of precision agriculture technologies in mitigating climate-induced risks and improving the sustainability of crop production systems, with particular emphasis on high-value horticultural crops. The integration of geospatial technologies such as remote sensing, geographic information systems, and global navigation satellite systems facilitates real-time monitoring of crop health, soil moisture, nutrient dynamics, and microclimatic variations. Advanced sensing platforms, including unmanned aerial vehicles and in-field sensor networks, enable early detection of climate-related stresses such as drought, heat stress, salinity, and pest and disease outbreaks. These technologies support timely and targeted interventions, reducing yield losses and optimizing input use efficiency. Digital innovations, including artificial intelligence, machine learning, big data analytics, and decision support systems, further strengthen climate adaptation by transforming large volumes of heterogeneous data into actionable insights. Predictive models and climate-informed advisories assist farmers in optimizing irrigation scheduling, nutrient application, and crop protection strategies under variable climatic conditions. Precision irrigation and variable rate technologies play a critical role in conserving water and minimizing environmental footprints, particularly in water-scarce and climate-vulnerable regions. Despite their immense potential, the adoption of precision agriculture faces challenges related to infrastructure, cost, data accessibility, and capacity building. Addressing these constraints through supportive policies, inclusive innovation, and farmer-centric digital ecosystems is essential for scaling climate-resilient agriculture. Overall, precision agriculture and digital innovations represent key enablers of sustainable, climate-adaptive crop production systems.

Keywords: Precision agriculture; Climate adaptation; Digital agriculture; Remote sensing; Decision support systems

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EFFECT OF FOLIAR APPLICATION OF AMINO ACIDS ON YIELD, ECONOMICS AND CORRELATION STUDIES OF TURMERIC

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The application of amino acids is considered an innovative and eco-friendly technique to enhance sustainable agricultural production by improving plant physiological processes and nutrient use efficiency. With a specific focus on turmeric cultivation, the present study aimed to evaluate the potential effects of different amino acids on yield and economic returns. The treatments consisted of foliar application of glutamine, glycine, lysine, phenylalanine and aspartic acid, each applied at four concentrations (50, 100, 150, and 200 ppm), along with control. The results revealed that the highest projected yield and benefit–cost ratio were associated with the application of glutamine at 200 ppm, followed by aspartic acid at 200 ppm. In general, increased and maximum yield was recorded at the higher concentration levels for all tested amino acids. This improvement can be attributed to the role of amino acids in enhancing metabolic activities, photosynthetic efficiency and nutrient translocation, which collectively promote better rhizome development in turmeric. Furthermore, a highly positive correlation was observed among growth, yield and quality parameters, indicating that improvements in vegetative growth directly contributed to enhanced yield and quality of turmeric rhizomes. Based on the findings of the study, the use of amino acids particularly glutamine and aspartic acid at higher concentrations can be recommended as a sustainable and economically viable practice for improving turmeric production and profitability.

Key words: Turmeric, Amino acids, Economics, Yield, Correlation, Glutamine.

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Integrated Water and Nutrient Management via Drip Fertigation and Mulching for Sustainable Mango Production in Semi-Arid Regions

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Soil moisture and nutrients are critical for agricultural productivity, especially in arid and semiarid regions where they limit crop growth. This study examines the combined use of irrigation, mulching, and fertigation in southern Telangana, India, to enhance water and nutrient availability, assessing soil and leaf nutrient dynamics, fruit yield, and quality of mango. The present experiment conducted over two years with 16 treatments replicated thrice, it includes four irrigation (basin irrigation at 1.2 m³/plant every 10 days, drip at 75%, 100%, 125% ETc daily) and four fertilization levels (500 g N&K via soil post-fruit set, 250, 375, 500 g of N&K via fertigation in three equal doses at 15-day intervals post-fruit set) and all the plants were mulched with silver colored polyethylene of 100 microns. The study found that 125% ETc with 375 g N&K fertigation and mulching significantly enhanced leaf nutrient and soil moisture availability (50%), water and nutrient use efficiency, fruit yield (60%), quality, and benefit-cost ratio, while saving 12.5% fertilizer compared to basin irrigation (1.2 m³ water) with 500 g N&K soil application. Similarly, 75% ETc with 500 g N&K fertigation and mulching improved leaf, soil nutrients, moisture, water and nutrient use efficiency, fruit yield (50%) and with 30% water savings compared to basin irrigation and soil fertilization. Future studies should validate these findings across diverse soil and climates to confirm the broader applicability of 125% ETc drip irrigation with 375 g N&K fertigation plant^{-1} and mulching as a fertilizer-saving approach, and 75% ETc drip irrigation with 500 g N&K fertigation plant^{-1} and mulching as a water-saving approach for mango cultivation.

Key words: Water use efficiency (WUE), nitrogen and potassium use efficiency N&KUE, Soil moisture availability, etc.

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Protected Cultivation: A Sustainable Strategy for Improving Productivity, Quality, and Export Potential of Fruit Crops in India

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India ranks as the second largest producer of fruit crops globally, yet it lags in productivity, quality, and export potential due to small land holdings, rain-fed farming, excessive reliance on chemical fertilizers and pesticides, physiological disorders, pests, pathogens, and adverse biotic and abiotic factors. These challenges also contribute to environmental pollution and limit export suitability owing to chemical residues. Protected cultivation (such as greenhouses, nets, and screen houses) offers a promising solution by providing a controlled environment that mitigates climatic extremes, reduces pest and disease incidence, enables off-season and early production, improves yield and fruit quality, and enhances economic returns. Studies on various fruit crops—including mango, banana, grape, peach, and custard apple—demonstrate that protected systems lead to favorable microclimate modifications (e.g., moderated temperatures, increased humidity, reduced wind and evaporation), enhanced vegetative growth (e.g., greater plant height, leaf number, and stem diameter), earlier flowering and maturity (e.g., 9–20 days earliness in several crops), higher yields (e.g., up to 53% increase in banana), and superior quality parameters (e.g., larger bunches, higher soluble solids, and better biochemical content in some cases). Economically, protected cultivation, despite higher initial costs, delivers significantly greater net returns over time compared to open-field methods, as evidenced by higher total production, revenue, and profitability in crops like mango and navel orange. Overall, protected cultivation promotes sustainable, high-quality fruit production, earliness, consistent yields, and improved export competitiveness in India and similar regions.

Key words: Protected cultivation, fruit crops, yield, quality, earliness, economics, biotic and abiotic factors.

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Root-Knot Nematode (*Meloidogyne* spp.) Infestation in Chilli: Occurrence and Management

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Chilli (*Capsicum annuum* L.) is an economically important vegetable and spice crop, but its productivity is severely constrained by root-knot nematode infestation caused mainly by *Meloidogyne incognita* and *M. javanica*. The occurrence of root-knot nematodes is widespread in chilli-growing regions, particularly in light-textured soils and warm climatic conditions, where they cause significant yield losses. Infested plants exhibit characteristic root galls, stunted growth, leaf yellowing, wilting during hot periods, reduced flowering, and poor fruit set due to impaired water and nutrient uptake. High nematode populations in nursery beds and continuous monocropping further aggravate the problem, leading to rapid population build-up and increased crop damage.Effective management of root-knot nematodes in chilli requires an integrated approach combining cultural, biological, and chemical methods. Cultural practices such as crop rotation with non-host crops, deep summer ploughing, soil solarization, and the use of nematode-free seedlings help in reducing initial nematode populations. Application of organic amendments like neem cake and farmyard manure improves soil health while suppressing nematode activity. Biological control agents, including *Paecilomyces lilacinus*, *Pochonia chlamydosporia*, and *Trichoderma* spp., have shown promising results in reducing egg viability and juvenile populations. Resistant or tolerant chilli varieties, where available, offer a sustainable management option. Although chemical nematicides provide quick suppression, their use should be minimized due to environmental concerns. Overall, integrated nematode management strategies offer an effective, eco-friendly, and sustainable solution for mitigating root-knot nematode infestation and improving chilli productivity

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HYDROPONICS: SUSTAINABLE AND HIGH-YIELD VEGETABLE CULTIVATION

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Hydroponics, a soilless cultivation technique, has emerged as an innovative and sustainable approach for producing high-value vegetables with improved efficiency and quality. In hydroponic systems, plants are grown in nutrient-rich water solutions, allowing precise control over essential elements, pH, and water availability, which promotes faster growth and higher yields compared to traditional soil-based cultivation. Commonly grown vegetables in hydroponics include tomato, cucumber, lettuce, spinach, bell pepper, and herbs, making it suitable for both commercial and urban farming. Hydroponic techniques such as Nutrient Film Technique (NFT), Deep Water Culture (DWC), aeroponics, and drip systems enable year-round production while optimizing space through vertical farming and controlled-environment agriculture. The method reduces water usage by 70–90%, minimizes the risk of soil-borne diseases and pests, and allows cultivation in areas with poor or contaminated soils. Despite requiring higher initial investment and skilled management for nutrient balance, system monitoring, and disease control, hydroponics offers a reliable solution for sustainable vegetable production. By integrating modern technology and soilless farming practices, hydroponics ensures high-quality, pesticide-free produce, maximizes resource use efficiency, and supports food security. Overall, hydroponics represents a transformative tool for modern agriculture, providing a sustainable pathway for meeting the increasing demand for fresh vegetables in urban and peri-urban regions.

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LETTUCE: A FUNCTIONAL LEAFY VEGETABLE FOR HEALTHY DIETS

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Lettuce (*Lactuca sativa* L.) is a widely consumed leafy vegetable recognized for its nutritional value and functional food properties, making it an important component of healthy diets. It is low in calories and fat while being rich in water content, which supports hydration and weight management. Lettuce provides essential dietary fiber that aids digestion, improves gut health, and helps prevent constipation. It is a good source of vitamins, particularly vitamin A (as beta-carotene), vitamin C, vitamin K, and folate, which play vital roles in vision, immune function, blood coagulation, and cellular metabolism. In addition, lettuce contains important minerals such as potassium, calcium, magnesium, and iron, contributing to electrolyte balance, bone health, and muscle function.Lettuce is also rich in bioactive compounds including carotenoids, flavonoids, and phenolic antioxidants, which help reduce oxidative stress and lower the risk of chronic diseases such as cardiovascular disorders and certain cancers. Dark green and red lettuce varieties are especially rich in antioxidant content compared to light-colored types. Due to its easy digestibility, refreshing taste, and nutritional richness, lettuce is suitable for all age groups. Overall, lettuce serves as a functional leafy vegetable that supports balanced nutrition, promotes overall health, and contributes to disease prevention in modern diets.

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ENTOMOPATHOGENS AS TRANSFORMATIVE TOOLS IN PEST MANAGEMENT

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The need for safer and more sustainable pest management methods has increased due to growing problems such as insecticide resistance, environmental pollution and harmful effects on beneficial organisms. In this context, entomopathogens, which include bacteria, insect-killing fungi, nematodes and viruses are considered effective tools for controlling insect pests without damaging the agroecosystem. Entomopathogens kill insects by infecting them, multiplying inside their bodies and causing death in a host-specific manner, unlike chemical insecticides. The effectiveness and field performance of entomopathogens have improved with recent innovations in formulation techniques, microbial research and molecular tools. Better selection of strains, improved mass production methods and advanced formulations have increased their storage life, virulence and tolerance to environmental stresses such as high temperatures, dry conditions and sunlight. Entomopathogenic fungi and bacteria generally infect insects by penetrating the cuticle, producing toxins and weakening the insect immune system. Viral pathogens are highly specific to target pests and cause lethal infections. Entomopathogenic nematodes provide additional control options by using insect behaviour and soil conditions to locate and infect hidden pest stages. When used as part of Integrated Pest Management (IPM), entomopathogens help reduce insecticide resistance, protect natural enemies and lower chemical residues in crops and the environment. Studies reveal that combining entomopathogens with low doses of insecticides, cultural practices or pheromones can improve pest control under field conditions. However, challenges such as regulatory issues, dependence on environmental conditions and variable field performance still limit their wider use. Accordingly, entomopathogens offer a strong biological approach to pest management and continued research is needed to improve their delivery, formulation and field reliability for sustainable crop protection.

Keywords: Entomopathogens, Biological pest control, Integrated Pest Management (IPM), Insecticide resistance management, Sustainable crop protection

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NANO INSECTICIDES AND NOVEL DELIVERY SYSTEMS: ADVANCING PRECISION PEST MANAGEMENT

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The usage of insecticides is becoming difficult due to major problems such as resistance developing in insect pests, harmful effects on natural enemies, persistence in the environment and regulatory restrictions. These challenges have made researchers search for new alternative insecticides that are precise and environmentally friendly. Hence, nano insecticides and their precise action are identified as potential tools for modern pest management. These are developed by reducing particle size so that insecticidal substances can be delivered accurately. Nano-based formulations protect active ingredients from rapid breakdown and allow them to easily reach target insects. Materials such as nanoemulsions, nanogels, liposomes, polymer particles and mineral-based carriers have shown improved movement of insecticides across the insect cuticle under field conditions and increased stability. Encapsulating chemical insecticides, microbial toxins, RNA-based agents or plant-based compounds in nanocarriers often allows lower doses to be used without reducing control efficiency. Some nano delivery systems are designed to release the active ingredient only under specific conditions, such as enzyme activity or changes in pH inside the insect body. This mechanism helps reduce exposure to natural enemies. New application methods including treated seeds, foliar sprays, nano baits, and attract-and-kill formulations also help match insecticide delivery with insect feeding and movement behaviour. Combining nano insecticides with biological control agents or pheromones may further improve pest control while conserving natural enemies. Although these technologies show strong potential, concerns related to environmental safety must be addressed carefully. Researchers need to evaluate these nano insecticides to ensure they are precise, efficient and capable of leading to sustainable pest management.

Keywords: *Nano insecticides; Targeted delivery systems; Insecticide resistance; Natural enemy conservation; Sustainable pest management*

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IMPROVING PARENTAL LINES FOR BACTERIAL BLIGHT RESISTANCE: ACCELERATING RICE HYBRID DEVELOPMENT THROUGH MARKER-ASSISTED BACKCROSS BREEDING (MABB)

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Hybrid rice technology provides over 20% higher yields than pure line varieties, relying on the development of superior parental lines for success. In this study successful marker-assisted introgression of three key bacterial leaf blight (BLB) resistance genes *Xa21, xa13* and *xa5* into elite restorer RP5933-1–19-2R for hybrid development. True F_1 plants harbouring all target genes were identified using gene-specific markers, and subsequent backcrossing was employed to develop BC_1F_1 and BC_2F_1 generations. Foreground selection coupled with background selection using identified 73 polymorphic SSR markers between parents, facilitated the recovery of up to 93.2% of the recurrent parent genome in selected BC_2F_1 plants. Field evaluations demonstrated that the improved BC2F3 lines exhibited significantly enhanced resistance to BLB, scoring between 1 and 3 on the disease severity scale, compared to the susceptible check. In addition, agronomic assessments revealed that the improved lines maintained or exceeded the grain yield and desirable traits of the recurrent parent, viz., days to flowering, plant height and panicle length. The introgressed lines, carrying the major fertility restorer gene *Rf4* along with BLB resistance genes, also proved to be an effective restorer while crossed with WA-CMS lines and demonstrated superior yield heterosis. The improved BLB-resistant restorer lines through marker-assisted backcross breeding for developing new rice hybrids are highly beneficial and would contribute to sustainable rice production and enhanced food security.

KEYWORDS: Marker-assisted backcross breeding (MABB), WA-CMS, Rice hybrids, Bacterial blight, Restorers

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GENETIC VARIABILITY, HERITABILITY AND GENETIC ADVANCE FOR YIELD AND YIELD RELATED TRAITS IN RICE (*Oryza Sativa* L.)

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To evaluate genetic variability, heritability and genetic advance for key agronomic traits in rice to identify traits with high potential for selection and improvement in breeding programs. The experiment was conducted in a randomized block design (RBD) with three replications. Regional Sugarcane and Rice Research Station (RS&RRS), Rudrur, Nizamabad, during the *kharif* 2022 season. Eighteen Advanced Varietal Trial (AVT) entries were evaluated with a spacing of 20 cm × 15 cm. Data were recorded from five randomly selected plants per entry in each replication for agronomic and yield-related traits: days to 50% flowering (DFF), plant height (PH), panicle length, number of panicles per square meter, filled grains per panicle, 1000-grain weight, and grain yield per hectare (GY/ha). Analysis of variance (ANOVA) and genetic parameters, including environmental coefficient of variation (ECV), genotypic and phenotypic coefficients of variation (GCV and PCV), heritability (h^2), and genetic advance as a percentage of the mean (GAM), were calculated using Windostat Version 9.1. The ECV was low across all traits, indicating minimal environmental influence. GCV was low for DFF (4.957%) and PH (4.789%) but moderate for filled grains per panicle (15.874%) and 1000-grain weight (16.33%). PCV was slightly higher than GCV for most traits, confirming limited environmental effects. Heritability ranged from medium (37.4% for GY/ha) to very high (99.7% for 1000-grain weight). GAM was high for filled grains per panicle (31.96%) and 1000-grain weight (33.586%), indicating strong potential for genetic improvement.

KEYWORDS: Rice breeding, phenotypic variation, genotypic variation, yield improvement

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Evaluation of F_2 Populations by Phenotypic and Genotypically in Rice (*Oryza sativa* L.) under Salt Stress

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The experiment was conducted during *Kharif* 2021 at Agricultural Research Station Kampasagar. It is difficult to breed for salinity resistance because salinity is one of the greatest barriers to the production of cereals worldwide. The advancement is further hampered by the small gene pools, the combined knowledge of the osmotic stress/tissue tolerance mechanism or mechanisms, including the build up of Na^+, and the lack of appropriate screening techniques. Screening of F_2 populations based on phenotype was done at Agricultural Research Station, Kampasagar and genotype was at ICAR-Indian Institute of Rice Research, Hyderabad, Rajendranagar, India. Six crosses of F_2 populations were screened under salt stress conditions. Out of six crosses, four crosses had plant survival, while the remaining crosses had no survival percentage. Validation of markers helps in determining the reliability and practical applicability of the markers in predicting the phenotype. In the present study, Simple sequence repeats (SSR) markers RM10793, RM562 and RM493 utilized to explain high percentage phenotypic variation. The PIC value of markers is 0.590, 0.490 and 0.522 located on chromosome number 1. Marker validation on independent populations of different genetic background is essential in determining the effectiveness of the markers to predict phenotype which indicates whether or not a marker could be used in routine screening for marker assisted selection.

Keywords: Rice, Salinity, Marker validation, Evaluation.

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AREA WIDE COMMUNITY EXTENSION APPROACH FOR BIO-MANAGEMENT OF COCONUT PEST

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Coconut (*Cocos nucifera*) is a vital plantation crop in India, predominantly cultivated by small and marginal farmers, where pest infestations particularly the coconut rhinoceros beetle (*Oryctes rhinoceros*) pose a major constraint to productivity and sustainability. Conventional, farm-level pest management practices have shown limited effectiveness due to the area-wide nature of pest breeding and the poor adoption of bio-control technologies. In this context, the ICAR–Central Plantation Crops Research Institute (CPCRI) developed and piloted an Area-Wide Community Extension Approach (AWCA) to promote the bio-management of rhinoceros beetle using *Metarhizium anisopliae* under an Integrated Pest Management (IPM) framework. The approach was implemented through participatory action research in contiguous coconut-growing areas, engaging farmers, women self-help groups, local self-government institutions, extension agencies, and mass media. Decentralized farm-level production of bio-agents, community mapping of pest breeding sites, synchronized area-wide interventions, and integration of indigenous technical

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ADVANCED CROP IMPROVEMENT AND BIOTECHNOLOGICAL INNOVATIONS

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Advanced crop improvement strategies are central to the development of future-ready agricultural systems capable of meeting growing food and nutritional demands. Recent advancements in molecular breeding, genome editing, speed breeding, and high-throughput phenotyping have significantly accelerated the development of improved crop varieties. These technologies enable precise manipulation of genes associated with yield, stress tolerance, quality traits, and resource-use efficiency. Integration of conventional breeding with modern biotechnological tools reduces breeding cycles and enhances selection accuracy. Genome editing technologies, in particular, offer opportunities to develop climate-resilient and nutritionally enhanced crops without introducing foreign DNA. Biotechnological innovations also support sustainable agriculture by reducing dependency on chemical inputs and improving resistance to biotic and abiotic stresses. Despite their potential, challenges related to regulatory frameworks, public perception, and equitable access remain critical. Strengthening biosafety regulations, transparent communication, and capacity building is essential for responsible deployment. Advanced crop improvement will play a pivotal role in enhancing agricultural productivity, resilience, and sustainability, making it a cornerstone of futuristic agriculture and global food security.

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PREDATORY POTENTIAL OF COCCINELLID BEETLES AGAINST MAJOR SUCKING PESTS

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Sucking pests cause severe yield losses in many agricultural crops, and biological control using natural enemies offers an eco-friendly management option. The present study evaluated the predatory efficiency of the coccinellid beetle *Coccinella septempunctata* against major sucking pests, viz., aphids (*Aphis gossypii*), jassids (*Amrasca biguttula biguttula*) and whiteflies (*Bemisia tabaci*), under laboratory conditions. Predation was recorded over a 24-hour period for different developmental stages of the predator. The fourth instar larva consumed the highest number of prey, with mean predation of 36.5 ± 1.8 aphids, 28.4 ± 1.5 jassids and 24.7 ± 1.3 whiteflies per day, followed by adult beetles which consumed 32.4 ± 1.6 aphids, 25.6 ± 1.4 jassids and 22.1 ± 1.2 whiteflies per day. Lower predation rates were observed in early larval instars. Predation increased significantly with advancement in larval stage. Among the pests, aphids were more preferred than jassids and whiteflies. The study clearly demonstrates that coccinellid beetles possess high predatory potential against major sucking pests and can effectively contribute to their biological suppression. Conservation and augmentation of coccinellids should therefore be encouraged in integrated pest management programmes.

Key words : Coccinellid beetles, *Aphis gossypii*, *Bemisia tabaci*, *Amrasca biguttula*, Integrated pest management.

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SOLAR-POWERED VERTICAL HYDROPONIC GROWTH TOWER FOR URBAN HORTICULTURE

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Urban areas have limited land for crop cultivation, but the demand for fresh vegetables and fruits is increasing. To solve this problem, a solar-powered vertical hydroponic growth tower can be used. This system allows plants to grow without soil in a vertical structure, making it suitable for cities where space is limited. In this system, plants are grown in stacked layers using nutrient-rich water instead of soil. The water containing essential nutrients is circulated through the plant roots and reused, which reduces water wastage. hydroponic technique helps eliminate the need for soil by supplying a nutrient-rich fluid that contains the necessary nutrients which directly reaches plant roots and encourages growth. Plants can be grown with their roots submerged in a nutrient-rich mineral solution or in an inert medium like perlite, gravel, or mineral wool. Since the structure is vertical, more plants can be grown in a small area compared to traditional farming. The growth tower is powered by solar energy. Solar panels provide electricity to run water pumps and control units. This reduces dependence on external power sources and makes the system eco-friendly. The use of renewable energy also lowers operating costs. This system is useful for growing leafy vegetables, herbs, and small fruit crops. It can be installed on rooftops, balconies, or open urban spaces. Overall, the solar-powered vertical hydroponic tower helps in efficient use of space, water, and energy while supporting sustainable urban horticulture.

Keywords: Solar energy, Sustainable Horticulture, Hydroponic towers, Urban horticulture.

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Genome configuration of satellite DNA beta molecule associated with Mungbean yellow mosaic India virus Gujarat , India

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Recent progress in genomic research has provided valuable insights into the complex biology of plant pathogens. The present study reports a notable association between DNA beta and MYMIV-[IN:Ana: CpMBKA25:04], a strain comprising 1,367 nucleotide base pairs, which has generated considerable scientific interest. Sequence identity matrix analysis indicated that this strain exhibits 96% sequence similarity with Potato apical leaf curl virus, followed by 95.3% similarity with Tomato leaf curl beta satellite virus (Accession No. AY230138). In contrast, a markedly lower similarity of 45.7% was observed with Bhendi yellow vein beta satellite (Accession No. AJ308425) when compared across seventeen DNA beta isolates infecting different host crops. The beta satellite sequence displayed characteristic genomic features, including a conserved putative stem–loop structure (TAATATT/AC) within the common region and a repeated GCTACGC motif. Additionally, an A-rich region extending from nucleotide positions 910 to 1120 was identified, contributing to the distinct genomic architecture of this strain. Amino acid sequence analysis revealed the presence of three additional residues V, C, and N at the C-terminal end of the βC1 protein, distinguishing it from related isolates. Identity matrix analysis showed a 95.9% similarity of the βC1 protein with those associated with Tomato leaf curl Karnataka virus and Potato apical leaf curl virus. Phylogenetic analysis further classified the beta satellite associated with MYMIV-[IN:Ana: CpMBKA25:04] as a separate lineage within the Papaya leaf curl virus group, highlighting its unique evolutionary position and biological relevance in plant virology.

Keywords: An A-rich region spanning from nucleotides 910 to 1120 further adds to the genetic complexity of this novel strain.

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Exploitation of Genetic Divergence for Yield and Quality Advancement in Rice traditional varieties and cultivars (*Oryza sativa* L.)

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The present investigation was conducted at the Regional Agricultural Research Station, Warangal, to evaluate genetic divergence and variability among 29 rice genotypes comprising landraces and improved cultivars, with the objective of identifying effective selection criteria for yield and quality improvement. Assessment of 29 agro-morphological, yield, and quality traits revealed highly significant differences among genotypes, reflecting the existence of substantial genetic variability. Genotypic coefficients of variation were consistently lower than phenotypic coefficients, indicating environmental influence on trait expression; however, traits such as plant height, number of productive tillers per plant, panicle length, number of grains per panicle, 1000-grain weight, grain dimensions, and grain yield per plant exhibited moderate to high variability along with high heritability and high genetic advance as per cent of mean, suggesting the predominance of additive gene action and scope for improvement through simple selection. Important yield-contributing traits, particularly number of grains per panicle, 1000-grain weight, grain length, and grain width, exerted substantial direct influence on grain yield, highlighting their relevance as key selection criteria. Mahalanobis' D^2 analysis grouped the genotypes into eight distinct clusters, with maximum inter-cluster divergence observed between clusters IV and VI, IV and VII, and IV and VIII, indicating considerable genetic diversity and potential for exploitation through strategic hybridization to obtain transgressive segregants. Grain width, 1000-grain weight, and plant height contributed most to total genetic divergence. The study concludes that selection for optimal plant height, enhanced panicle length, and increased grain number per panicle can effectively improve grain yield while maintaining desirable quality attributes, thereby supporting focused and efficient rice breeding programmes.

Keywords: Genetic divergence, rice, yield components, Mahalanobis' D^2, hybridization, selection criteria

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GENOTYPIC AND PHENOTYPIC CORRELATION COEFFICIENTS AMONG FOURTEEN YIELD COMPONENTS IN BITTER GOURD (*Momordica charantia* L)

M. Mahesh, Dr RVSK Reddy and Dr. P. Saidaiah

An experiment was conducted during *rabi* 2012–13 at Vegetable Research Station, Dr. Y.S.R. Horticultural University, Rajendranagar, Hyderabad to estimate genotypic and phenotypic correlation coefficients among fourteen yield contributing characters in bitter gourd (*Momordica charantia* L.). The experimental material consisted of seventeen genotypes comprising ten F_1 hybrids derived through half diallel mating design, five parental lines and two commercial checks evaluated in Randomized Block Design with three replications. In general, genotypic correlation coefficients were higher than phenotypic correlations, indicating strong inherent genetic association among the traits with partial environmental influence on phenotypic expression. Fruit yield per vine exhibited highly significant and positive association with number of fruits per vine, number of primary branches per vine, days to last fruit harvest, vine length and fruit flesh thickness at both genotypic and phenotypic levels. Among these, number of fruits per vine recorded the strongest positive correlation with fruit yield. The results indicated that these traits could be effectively utilized as selection criteria for improving yield potential in bitter gourd breeding programmes.

Key words: Genotypic correlation, Phenotypic correlation, Yield components, Selection criteria.

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STUDIES ON SPECIFIC COMBINING ABILITY IN BITTER GOURD (*Momordica charantia* L)

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The present investigation was carried out to assess specific combining ability effects in bitter gourd for yield and related traits using ten F_1 hybrids generated through half diallel crosses. The experiment was conducted during *kharif* and *rabi* seasons, 2012 at Vegetable Research Station, Rajendranagar, Hyderabad in Randomized Block Design with three replications. Highly significant SCA effects were observed for most of the characters indicating predominance of non-additive gene action. The cross combinations RNMC-53 × RNMC-55 and RNMC-52 × RNMC-55 exhibited high positive SCA effects for fruit yield per vine and number of fruits per vine. RNMC-51 × RNMC-53 recorded superior SCA effects for vine length, days to last fruit harvest and fruit yield. The results suggested that these superior cross combinations can be exploited for heterosis breeding and commercial hybrid development in bitter gourd.

Key words: Bitter gourd, Specific combining ability, Non-additive gene action, Heterosis, Hybrid breeding.

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APPLICATIONS OF DRONE TECHNOLOGY IN AGRICULTURE AND HORTICULTURE

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Drone technology has emerged as a transformative tool in modern agriculture and horticulture, offering innovative solutions to improve productivity, sustainability, and resource management. Unmanned Aerial Vehicles (UAVs), commonly known as drones, enable precise monitoring of crops through high-resolution imaging, multispectral sensors, and real-time data collection. These capabilities assist farmers in assessing crop health, detecting pest infestations, identifying nutrient deficiencies, and managing irrigation more efficiently. In horticulture, drones support tasks such as canopy analysis, plant growth monitoring, and yield estimation, contributing to improved decision-making and reduced labor requirements. The integration of drone technology promotes precision farming practices, minimizes the excessive use of water, fertilizers, and pesticides, and enhances overall farm efficiency. Despite challenges such as high initial costs, regulatory limitations, and the need for technical expertise, the adoption of drones continues to expand due to their long-term economic and environmental benefits. This study highlights the key applications, advantages, and future potential of drone technology in advancing sustainable agriculture and horticulture systems.

Keywords: Drone Technology, Precision Agriculture, Horticulture, Crop Monitoring, Sustainable Farming

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