Sovenir & Abstracts

1st Zonal Convention- North East Bharat

on

पूर्वी हिमालय क्षेत्र में आत्मनिर्भर भारत के लिए भविष्य की कृषि

Futuristic Agriculture for Atmanirbhar Bharat in the Eastern Himalayan Region

Organized by

Vidyarthi Nidhi

AGRIVISION-2024

May 17-18, 2024

In Collaboration with

Editors

Dr. Pramod Kumar Pandey
Mr. Shubham Singh Patel
Mr. Deepak Kumar Dwivedi
Mr. Vishwanath V. Walawalkar
Mr. Mebanlamshwa Jyrwa

Venue: CPGS-AS, CAU (Imphal), Umiam, Meghalaya

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Citations: Pandey, P. K., Patel, S. S., Dwivedi, D. K., Walawalkar, V. V., Jyrwa, M. 2023. "Souvenir and Abstracts Book" 1st Zonal Convention- North East Bharat on "Futuristic Agriculture for Atmanirbhar Bharat in the Eastern Himalayan Region" May 17-18, 2024 at CPGS-AS, CAU (Imphal), Umiam, Meghalaya. (pp…).

Note: Opinions in this publication are those of authors and not necessarily of the organizers.

Published by:

Vidyarthi Nidhi, Mumbai

सत्यमेव जयते

CHIEF MINISTER
MANIPUR

MESSAGE

It gives me immense pleasure to learn that AGRIVISION is organising the 1st Zonal Convention- North East Bharat on "Futuristic Agriculture for Atmanirbhar Bharat in the Eastern Himalayan Region" on 17th and 18th May, 2024.

Agriculture is one of the largest contributors to the Gross Domestic Product of our country. A large part of the population of the Eastern Himalayan Region and the country still depend on agriculture and its allied activities as their principal means of livelihood. In the pursuit of self-reliance, agriculture sector stands at the threshold of a transformative journey into the future. To realize the vision of Atmanirbhar Bharat, it is imperative to embrace futuristic approaches in agriculture, leveraging cutting-edge technologies, sustainable practices, and innovative strategies. I believe that our country will emerge as a global leader in agricultural resilience, productivity, and sustainability.

I wish all the participants a productive session and extend my best wishes for the successful organisation of the convention.

(N. Biren Singh)

VC SIR CAU

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MESSAGE

Agriculture, the timeless bond between humanity and the earth, has traversed epochs of evolution, from ancient practices to today's cutting-edge innovations. Yet, amidst this journey, challenges have emerged, impacting both nature and society. Now, as we convene for the Zonal Convention-North East Bharat, our focus sharpens on the Eastern Himalayan Region, heralding a new chapter in agriculture: "Futuristic Agriculture for Atma Nirbhar Bharat."

The North-Eastern expanse of India stands as a testament to agricultural diversity and resilience, where tradition meets innovation, and biodiversity thrives. Here, amidst the verdant landscapes, unique products like Khasi mandrin, Arunachal orange, and Lakadong turmeric have not just flourished but have been recognized globally for their excellence.

But beyond the bounty of nature lies a deeper narrative—the story of communities deeply rooted in their heritage, navigating the delicate balance between tradition and progress. As we look ahead, the convergence of traditional wisdom and modern technology emerges as the guiding principle towards self-reliance, or **"Aatma Nirbhar Bharat."**

The path to this self-reliance isn't solitary but communal, inclusive of the vibrant youth whose innovation and zeal breathe life into every field and farm. Empowering them, preserving cultural legacies, and fostering a spirit of innovation will pave the way for a resilient agricultural sector.

In our pursuit of a sustainable future, the integration of smart-agriculture emerges as a beacon of hope. It is not just about harnessing technology but about infusing it with the essence of tradition, creating a landscape that thrives amidst adversities, ensuring food security, and preserving the sanctity of the land.

As we embark on this journey, let us pledge to preserve our natural resources, to nurture our agricultural systems, and to empower our communities. The time is ripe for North-East India to embrace a localized version of smart agriculture, one that inspires the youth, sustains the heritage, and ensures prosperity for generations to come.

Together, let us sow the seeds of innovation, cultivate resilience, and reap the harvest of a truly Atma Nirbhar Bharat.

I convey my best wishes to the organisers of 1st Zonal Convention- North East Bharat on "Futuristic Agriculture for Atma Nirbhar Bharat in the Eastern Himalayan Region (FAAB-HER)"

Prabha Shankar Shukla

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LEAD PAPERS

Artificial Intelligence (AI) for Futuristic Agriculture

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Introduction

It is an emerging and dynamic field, which includes computer science and data science, to enable problem-solving and taking decision for betterment and enhancing efficiency of system. Artificial Intelligence (AI), Machine Learning (ML) and Deep Learning (DL) is used for crop monitoring and forecasting based on image, voice and speech recognition for increasing production and productivity. Its accuracy depends on reliability and accuracy of data.

As collection, analysis, interpretation and finally presentation and organization in original hypothesis is important part in this exercise. It also encompasses sub-fields of Machine Learning (ML) and Deep Learning (DL), which are essential part of artificial intelligence. In fact ML is integral part of AI, and DL is essential part of ML. These disciplines (ML & DL) are comprised of AI algorithms which seek to create expert systems which make predictions for future yield and forecasting for making system perfect and for proper assessment or classifications based on input data relevant to subject matter.

Artificial Intelligence Applications

In present context, there are number of real-world applications of AI systems. Below are some of the most common applications:

- Speech Recognition: It is also known as automatic speech recognition (ASR), computer speech recognition (CSR), or speech-to-text system (STS), and it is a capability which uses Natural Language Processing (NLP) to process human speech into a written format for further analysis and interpretation. Many mobile devices incorporate speech recognition into their systems to conduct voice search- e.g. Siri in iphone- or provide more accessibility and existence around texts.
- Customer Service: Online chatbots are replacing human receptionist for assistance on the customer care desk. They answer frequently asked questions (FAQs) related to topics or subject, or provide personalized advice, cross-selling products or suggesting sizes for users, changing the way we think about customer reputation on websites and social media and what to do, not to do and how to do etc. Examples include messaging bots on e-commerce sites with virtual agents, messaging apps, such as Slack and Facebook Messenger etc, and tasks usually made by virtual and voice assistants.
- Computer Vision: This AI technology enables computers and systems to derive meaningful information and conclusions from digital images, photos, text, graphs, videos and other visual inputs, and based on these inputs, action on appropriate inferences can be taken. This ability to provide appropriate real time recommendations differentiates it from image recognition tasks. Powered by Convolution Neural Networks (CNN), computer vision has applications within photo tagging in social media for propagation and extension of technology, radiology imaging in healthcare for tracking, tracing, testing, treatment and therapy, and self-driving cars or tractors within the automotive and agriculture industry to saves human labor etc.
- Recommendation for Growth Engines or Way forward: Using past consumption behavior data, AI algorithms can help to discover data trends that can be used to develop more effective cross-selling strategies for increasing profitability and getting more remuneration. This is used to make relevant add-on recommendations to customers during the checkout process for online retailers and e-commerce activities.
- Automated stock trading: It is designed to optimize stock portfolios for future income and benefits. AI-driven high-frequency trading platforms make thousands or even millions of trades per day without human intervention in more efficient ways for more profits.

Applications of AI in Agriculture

Artificial Intelligence (AI) is used in many different industries, from manufacturing to automotive industries. One of the most interesting industries that AI is breaking into is agriculture. Agriculture is a major industry and a huge part of the foundation of our economy.

Presently in India about 19.9 % contribution is observed by agriculture in national GDP. AI systems are helping to improve the overall harvest quality of produce plus accuracy, reliability and perfection in different on farm applications, which is an essential part of precision agriculture. AI technology helps in detecting disease in plants, insects, pests & poor nutrition of farms and in term warn for maintaining quality of produce.

AI sensors can detect and target weeds and then decide which herbicide to apply within the region and with what quantity so that it should not have any gradual effect on soil and plant. As climates are changing and already attended worth position as far as its suitability for agriculture production is concerned. Further the population is also increasing gradually. In this context, AI is becoming a technological innovation for improving & protecting crop yield with high quality.

The most popular applications of Artificial Intelligence in agriculture industry are placed in four major categories, which are as follows:

1) Agricultural Robots and Automation including Driverless Tractor.
2) Predictive Analytics based on Crop & Soil Monitoring including Plantix app for Precision Farming.
3) Imagining Technology with Computer Vision & Deep-learning algorithms for analyzing Crop Health including Drone Applications.
4) Machine learning models for judging environmental impacts on crop yield and quality.

Agricultural Robots and Automation including Driverless Tractor

- AI companies are developing robots that can easily perform multiple tasks in farming fields.
- These robots are trained to control weeds and harvest crops at a faster pace with higher volumes compared to humans and trained to check the quality of crops.
- They detect weed with picking and packing of crops while combating other challenges within the agricultural labor force.
- Thus, Agricultural robots can protect crops from harmful weeds that may be resistant to herbicide chemicals that are essentially meant to eliminate them.
- These robots are also capable to fight with challenges faced by agricultural force labor like extreme summer, winter and rains etc.
- Robot mounted with a camera and a laser scanner can predict the expected yield of the plants and decide exact stage of full maturity and harvesting.
- A robot can help farmers pick and pack their crops; lack of laborers has led to revenue losses in the regions.
- According to present state of art technology available, the robot can harvest 8 acres in a single day and replace 30 human laborers.
- An estimated 40% of annual farm costs are consumed into "wages, salaries and contract labor expenses" for crops cultivation such as fruits and vegetables where labor needs tend to be the highest.
- Agricultural robots will save money, increase yields, reduce energy usage and improve quality, a robot can help farmers pick and pack their crops, technology can help farmers maximize their resources.
- It is likely to result in increased agricultural productivity and returns to investment & improved environmental sustainability.
- A robot using computer vision and working on principle of See & Spray to monitor & precisely spray to remove weeds from plants.
- Automation & robotics can help farmers find more efficient ways to protect their crops from weeds.
- Precision spraying can help prevent herbicide resistance and reduces cost of cultivation.
- Automation eliminates 80% of the volume of chemicals normally sprayed on crops and can reduce herbicide expenditures by 90%.
- Automation can help address challenges in the labor force; the agriculture is projected to experience a 6% decline in agricultural workers from 2014 to 2024.

- A driverless tractor is an autonomous farm vehicle that delivers a high tractive effort at slow speeds, for the purpose of tillage and other agricultural tasks; it can operate without the presence of a human inside the tractor itself.
- Self-driving tractors have the potential to optimize on-farm operations and offer a safer, less stressful working environment for farm workers and their families.
- Driverless tractors are programmed to observe their position, decide the speed and avoid obstacles such as animals, human beings or objects in the field performing their task.
- They operate with the aid of a supervisor monitoring the progress at a control station or with remote control from a distance.

Predictive Analytics based on Crop & Soil Monitoring including Plantix app for Precision Farming

- Predictive Analytics and Precision Farming is one of most advantageous tools in modern agriculture.
- AI applications in agriculture have developed applications and tools which help farmers in accurate and controlled farming by providing them proper guidance and advise to farmers about water management, crop rotation, timely harvesting, type of crop to be grown, optimum planting, pest attacks, nutrition management.
- Plantix app is a step forward for Predictive Analytics based on Crop & Soil Monitoring and essential tool for Precision Farming.
- A German-based tech start-up PEAT has developed an AI-based application called Plantix that can identify the nutrient deficiencies in soil including plant pests and diseases by which farmers can also get an idea to use fertilizer which helps to improve harvest quality.
- It is a scientific Soil and Crop Health Monitoring System and finally meant for predictive analysis.
- The type of soil and nutrition of soil plays an important role in the type and quality of crop to be grown.
- Due to increasing, deforestation and other natural disorders soil quality is degrading and it's hard to determine the quality of the soil suitable for crops.
- This app uses image recognition-based technology, can identify possible defects through images captured by the user's smartphone camera.
- They can also see soil restoration techniques with tips and other solutions through short videos on this application.
- Plantix app identifies potential defects & nutrient deficiencies in soil, the app uses images to detect plant diseases.
- This also offer possible collaboration, cooperation, coordination and networking among different stakeholders.
- The farmers can participate in the online community to network with other farmers to discuss plant health issues and access their local weather reports.
- Plantix can diagnose plant diseases, pest damages and nutrient deficiencies affecting crops and offers corresponding treatment measures.
- Users are provided with soil restoration techniques. Analysis is conducted by software algorithms which correlate particular foliage patterns with certain soil defects, plant pests & diseases.

Imagining Technology with Computer Vision & Deep-learning algorithms for analyzing Crop Health including Drone Applications

- Imaging technology can assist with overall field management, providing estimates in real-time identifying where specific crops may require more water, fertilizer, soil or pesticides.
- Employing the use of agricultural drones would help increase crop production and monitor crop growth.
- Drones that use AI help farmers to scan their fields and monitor every stage of the production cycle.
- This will help farmers to make data-driven decisions.
- AI & aerial technology can monitor crop health and predict crop yield.

- Drone is a tool of Computer vision & Deep-learning algorithms based on Imagine Technology for analyzing Crop Health.
- Drone technology helps users improve their crop yield & reduce costs.
- Users pre-program the drone's route and once deployed the device will leverage computer vision to record images which will be used for further analysis and interferences.
- When the drone completes its route, users can transfer a USB drive from the drone to the computer and upload the captured data to a cloud drive, It can use algorithms to integrate & analyze the captured images and data.
- Drones offer high-quality imaging that can help monitor crops while scanning and analyzing fields to collect necessary agricultural data.
- This imaging technology can assist in the identification of crops and their progress, including their health, and the determination of their readiness, these images can provide farmers with the ability to determine how ripe their crops are, and if and when they will be ready for harvest.
- Drone is AI-enabled system to detect Pests and Insects. Pests and insects are the worst enemies of the farmers which damages crops and drastically reduces yield both quality and quantity wise.
- AI systems use satellite images and compare them with historical data using AI algorithms and detect that if any insect has landed and which type of insect has landed like the locust, grasshopper, etc. Further, it send alerts to farmers to their smart phones so that farmers can take required precautions and use required pest control thus AI helps farmers to fight against pests.
- Agricultural drones allow farmers see their fields from the sky.
- This birds-eye view would expose intending issues on the farm such as irrigation problems, soil variation as well as pest and fungal infestations, having identified these issues, the farmer can come up with solutions to improve crop management and production.
- As farmers can depend on the data that drones record to determine the state of the farm rather than walking all the distance.
- This gives the farmer time to focus on the big picture of production and expansion instead of spending excess time surveying their crops and the state of the farm.
- This drone is mounted with a sensor that uses the same wavelength, the same science as a satellite so literally it is like we are capturing satellite data at greater detail.
- In agriculture, there are major applications of drone technology, such as crop monitoring, crop volume and vigour assessments, crop inventory, generation of prescription maps, precision spraying, an inspection of farm infrastructure, high-resolution mapping and surveying of individual fields, crop damage assessment & insurance claim forensics.
- Low-cost drones help farmers detect pests and diseases on their crops and make informed decisions for improving crop water efficiency & yields.
- The farmers use RGB cameras & near-infrared cameras mounted on the drones for surveillance and diagnose the plants for pests and diseases, water stress and nutrient deficiencies.
- Extension workers have been trained to operate the drones and capture, analyze and present findings to the farmers, most of whom, without the technology, would be unable to determine that their plants could be nutritionally deficient, water-stressed, or under attack by crop pests.
- Drones detect these subtle changes in the crops before they are discernible to the human eye, thus enabling early intervention and saving farmers from losses.
- SkySqurrel Technologies has also developed a techniques analyzing crop health by drone, which has brought drone-based Ariel imaging solutions for monitoring crop health.
- In this technique, the drone captures data from fields and then data is transferred via a USB drive from the drone to a computer and analyzed by experts.
- This company uses algorithms to analyze the captured images and provide a detailed report containing the current health of the field and its future. It helps the farmer to identify pests and insects helping farmers to timely use of pest control and other methods to take required action to protect crop.

Machine Learning Models for Weather Forecasting

- It is used to track & predict various environmental impacts on crop yield and quality such as weather changes and water stress.

- With the change in climatic condition and increasing pollution it's difficult for farmers to determine the right time for sowing seed, with help of Artificial Intelligence farmers can analyze weather conditions by using weather forecasting which helps they plan the type of crop can be grown and when should seeds be sown.
- While using the machine learning algorithms in connection with images captured by satellites and drones, AI-enabled technologies predict weather conditions, analyze crop sustainability and evaluate farms for the presence of diseases or pests and poor plant nutrition on farms with data like temperature, precipitation, wind speed, and solar radiation.
- Machine learning is used to provide an analysis of crop or soil health and it provides farmers and laborers with insights about the strengths & weaknesses of their soil.
- This is done with the intention of preventing and eliminating bad crops, and increasing the potential for healthy crops to grow.

Other application of AI in Precise Farming and Weather Forecasting

- Precision farming uses Artificial intelligence to generate accurate and controlled techniques that help offer guidance & understanding about water and nutrient management, optimal harvesting and planting times as well as when the right times for crop rotation would be,
- These processes make farming more efficient, and can help predict ROI on specific crops based on their costs and margin within the market.
- By including data, for example, climate conditions, kind of soil, commercial centers, potential invasions, and information in the algorithm.
- AI can decide the best seeds to utilize and assist farmers maximize production, this can improve the Return on Investment (ROI) for all farms.
- AI innovation can process investigations that help farmers minimize losses in the production supply chain of their farms.
- The industry is turning to AI technologies to help yield healthier crops, control pests, monitor soil, and growing conditions, organize data for farmers, help with the workload, and improve a wide range of agriculture-related tasks in the entire food supply chain.
- Farmers without connectivity can get AI benefits right now, with tools as simple as an SMS-enabled phone and the Sowing App. Meanwhile, farmers with Wi-Fi access can use AI applications to get a continually AI-customized plan for their lands.
- With such IoT- and AI-driven solutions, farmers can meet the world's needs for increased food sustainably growing production and revenues without depleting precious natural resources.
- In the future, AI will help farmers evolve into agricultural technologists, using data to optimize yields down to individual rows of plants
- Similarly, Trace Genomics is another machine learning-based company that helps farmers to do a soil analysis.
- Such type of app helps farmers to monitor soil and crop's health conditions and produce healthy crops with a higher level of productivity.

Conclusion

Artificial Intelligence in agriculture not only helping farmers to automate their farming but also shifts to precise cultivation for higher crop yield and better quality while using fewer resources and thus reducing cost of cultivation. Companies involved in improving Artificial Intelligence-based products or services for agriculture, either in the form of drone, and automated machine will get technological advancement in the future. This will definitively provide more useful applications to the agriculture sector to deal with food issues for the growing population.

Agrobiodiversity and Ethnobotany: Conservation, Utilization and Valuables

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Abstract

Agrobiodiversity, encompassing the rich variety and variability of plants, animals, and microorganisms utilized in agriculture and food production, is a cornerstone of sustainable farming practices globally. India, a biodiversity hotspot, boasts a diverse range of crops and species crucial for food security and cultural significance. Over millennia, farmers and breeders have shaped agrobiodiversity through deliberate selection, fostering traits such as yield, taste, and resilience to environmental challenges. India's agrobiodiversity is showcased through its 22 recognized hotspots, characterized by unique ecological features and historical agricultural practices. However, this diversity faces threats from urbanization, deforestation, and modern agricultural practices, highlighting the urgent need for conservation efforts. Conservation strategies encompass in situ and ex situ methods, alongside ecosystem-level approaches to safeguard genetic resources and traditional knowledge. Ethnobotany, a multidisciplinary field, explores the intricate relationships between people and plants, contributing significantly to medicine, healthcare, and sustainable development. Traditional ecological knowledge embedded in ethnobotany plays a pivotal role in addressing contemporary challenges across various domains, including conservation, food security, and cultural preservation. Chaudhary Charan Singh Haryana Agricultural University (CCS HAU) champions agrobiodiversity conservation through diverse initiatives like the Deendayal Upadhyay Centre of Excellence for Organic Farming, Agri-tourism Center, and annual Krishi Mela. These initiatives promote sustainable agriculture, disseminate scientific knowledge, and empower farmers with organic farming techniques and market opportunities. CCS HAU's role in developing and releasing diverse crop varieties underscores its commitment to supporting resilient agricultural systems suited to diverse agro-climatic conditions. Through outreach programs and community engagement, CCS HAU fosters societal awareness and knowledge exchange, contributing to the preservation and utilization of India's rich agrobiodiversity for future generations.

Keywords: Agrobiodiversity, ethnobotany, CCS HAU, hotspot, initiatives

Introduction

Agrobiodiversity is a vital subset of biodiversity, which is developed and actively managed by farmers, herders and fishers. It is the variety and variability of plants, animals, and microorganisms that are used directly or indirectly for agriculture and food production. Ethnobotany is the interdisciplinary study of the relationships between people and plants, focusing on how plants are used for various purposes within different cultures and societies (Nolan and Turner, 2011). This diversity has been shaped over thousands of years through several deliberate practices and processes. Over generations, farmers and breeders have engaged in deliberate selection of desirable traits in crops and livestock such as yield, taste, resilience to pests or diseases and adaptability to specific environmental conditions. To observe how they respond and adapt helps in identifying traits that are favourable for survival and productivity under different environmental circumstances. Field-level cross-breeding helps in creating new varieties that possess the best characteristics of the parent plants or animals, such as disease resistance, high yield, or improved nutritional content (Mittler and Blumwald, 2010). The long history of agriculture has led to the accumulation of a rich reservoir of genetic material. This genetic wealth is essential for developing resilient and adaptable crops and livestock in the face of evolving challenges. Different regions and cultures have cultivated and bred various species suited to local conditions, resulting in a vast array of agricultural biodiversity (Thrupp, 2000). Overall, agrobiodiversity encompasses four dimensions namely, genetic resources for food and agriculture, ecosystem services, abiotic factors and socio-economic and cultural dimensions.

Land used for agriculture currently makes up a sizable amount occupies half of the land that can support life and covers 48 million square km in total. One third of agricultural land is composed of crops and the other two thirds is made up of grazing area. But just half of the world's croplands are utilised to cultivate food that is directly consumed by people (Figure 1), shows permanent pastures, which include wild and cultivated forage crops, grassland and rangelands. In this instance, the increase in agricultural land is accompanied by a loss in forest and woodland area, as well as a fall in the category all other land. An increase in area assigned to one

classification unit must imply a decrease in some other land cover type (http://apps.fao.org). As per the FAO estimates for the year 2020, Land Area of the World is 12998 million hectares and roughly 4739 million ha (36.46% of the Land Area) is classified as 'agricultural area'. The agricultural area is the sum of arable land (28%), permanent crops (3%) and permanent meadows and pastures (69%). Among the 10 major countries of the world, Russia has the highest land area but China has the highest agricultural area. India is ranked 7th in land area and 6th in agricultural area. However, India has the second highest arable area after China. In terms of agricultural area as proportion of total land area, Nigeria is ranked first with 76.25% agricultural area and India is ranked second with 60.22% agricultural area. As per the FAO estimates for the year 2020, the Forest Area of the World is 4050 million hectares which constitutes 31.18% of the total land area. The global forest area has declined by about 91 million.

Significance of Agrobiodiversity for India

India is with a high degree of biodiversity country. A number of crops, including rice, sugarcane, coconuts, arecanut, brinjal, citrus, coffee, banana and cu-cumber species, and it is rich in food crops, oilseed crops, horticultural crops, spices, lichens, algae, fungi, insects and medicinal plants have their origins or diversities in India. India is one of the world's 12 mega diversity zones hub. In India over twenty-five crop species were domesticated. More than 18,000 species of higher plants have been identified, including 325 wild relatives and 160 main and minor agricultural species. Approximately 1,500 edible wild plant species are extensively used by indigenous people, 647 of fruits, 118 seeds and nuts, 145 varieties of roots and tubers, 521 leafy vegetables and greens, 101 buds and blooms, and 647 fruits are among them. Furthermore, reports of 9,500 plant species with ethnobotanical uses have come from the nation; roughly 7,500 of them are used for ethno medical purposes. India's traditional farming methods are largely balanced and robust. The rice varieties of Tamil Nadu (Konamani), Assam (Agni bora), Kerala (Pokkali), Himachal Pradesh's Bhalia Wheat, the native breeds of goats (34), sheep (43), chicken (19) and buffaloes (15) are among India's promising genetic resources. The species complexes seen in ancient agricultural systems are prime examples of how human tribes, pollinators, helpful insects, draught animals, friendly birds, earthworms, soil microbes, and biocontrol agents. Traditional agriculture has gradually been supplanted by modern farming systems, which developed in response to the expanding demands of human society to provide food and nutritional security.

For agrobiodiversity conservation in the Indian gene hub, a combination of ex situ and in situ conservation approaches is needed. Although the Agricultural Research Institutes' efforts are admirable, much work remains. Thankfully, the nation is open to international cooperation and exchange and is well-equipped with local resources and knowledge. Human resource development and institution building have advanced nicely in recent years. This can assist in the following ways because genetic variety of crops, livestock and their wild relatives is essential to improving crop types and livestock breeds: Out of 117 eligible countries, India is ranked 102 in the Global Hunger Index (GHI) for battling hunger. Because of chronic undernutrition or stunting, four out of ten children in India, or nearly 47 million, do not reach their full potential. According to the global nutrition report, 614 million women worldwide and over half of Indian women between the ages of 15 and 49 are anaemic.

Agrobiodiversity Hotspots in India: A Rich Tapestry of Agricultural Diversity

Agrobiodiversity hotspots in India refer to specific regions or areas within the country that exhibit exceptionally high levels of agricultural biodiversity and cultural significance. World agrobiodiversity is a reflection of the rich genetic resources that have been shaped and maintained by farmers, breeders, and indigenous communities over millennia. In India, there are indeed 22 recognized agrobiodiversity hotspots identified based on their unique biodiversity, ecological features, and cultural importance. These hotspots are spread across different states and regions of India and are characterized by a convergence of factors such as diverse agro-climatic conditions, historical agricultural practices, and local community engagement in sustainable farming. Some examples of these hotspots include regions like the Western Ghats, Eastern Himalayas, Indo-Gangetic Plains, Western Rajasthan, Deccan Plateau, and various other agro-ecological zones across the country (plantauthority.gov.in).

They are characterized by a variety of factors contributing to their significance and conservation efforts.

Crop Diversity

These hotspots showcase a rich diversity of crops including cereals such as rice, wheat, and millets; pulses like lentils and chickpeas; oilseeds such as mustard and sesame; a wide range of vegetables, fruits, and spices.

Livestock Diversity

The hotspots are home to diverse livestock species including cattle, goats, sheep, poultry, and others. Livestock diversity is important for food production, livelihoods, and cultural practices.

Traditional Farming Systems

Traditional farming practices in these hotspots include agroforestry, crop rotation, and organic farming techniques. These methods enhance sustainability, biodiversity, and resilience to environmental changes.

Conservation of Genetic Resources

Efforts in these hotspots focus on conserving and utilizing genetic resources to develop new crop varieties and livestock breeds that are resistant to pests, diseases, and environmental stresses. This is crucial for ensuring food security and agricultural sustainability.

Cultural Importance

Traditional farming techniques, seasonal festivals, and culinary traditions are deeply intertwined with agrobiodiversity, contributing to cultural diversity and identity.

The conservation and sustainable management of agrobiodiversity in these hotspots are vital for maintaining food and nutritional security, preserving cultural traditions, promoting biodiversity, and building resilience to climate change and other challenges in agriculture (Frison *et al*., 2001).

Degradation of Agrobiodiversity: Changing Patterns of Land Use and Agricultural Practices

The degradation of agrobiodiversity in India is intricately linked to changing patterns of land use and agricultural practices driven by urbanization, deforestation, agricultural modernization, and shifts in dietary preferences and supply chains.

The rapid pace of urbanization in India is resulting in the conversion of agricultural land into urban areas, leading to habitat loss for diverse crop varieties and indigenous species. This conversion disrupts agroecosystems, as forests and farmlands are replaced by concrete landscapes. Deforestation, often associated with urban expansion, further exacerbates the loss of agrobiodiversity by destroying natural habitats and altering ecological conditions essential for sustaining diverse crops and species. Monocultures and Abandonment of Traditional Practices: Modern agriculture trends towards monocultures of high-yielding crop varieties or livestock breeds, neglecting traditional farming practices that once supported diverse ecosystems. This shift contributes to genetic erosion as farmers abandon indigenous crop varieties adapted to local conditions in favor of uniform, commercially viable options (Satterthwaite *et al*., 2010). Monocultures deplete soil health through intensive chemical use, impacting biodiversity and disrupting natural ecological balances crucial for sustainable agriculture. Changing dietary preferences towards a more Westernized diet, characterized by increased consumption of processed foods, meat, and dairy products, shape agricultural production patterns. This shift drives up the demand for specific crops like soy and palm oil, altering land use to accommodate these globally traded commodities (Elouattassi *et al*., 2023). As a result, agrobiodiversity suffers due to the dominance of select crop varieties optimized for mass production and long-distance supply chains. The globalization of food supply chains further promotes uniformity and standardization, squeezing out diverse, locally adapted agricultural practices (Chaudhuri, 2005).

The degradation of agrobiodiversity in India is a multifaceted issue driven by urbanization, agricultural modernization favoring monocultures, and the globalization of diets and supply chains. Addressing this challenge requires a holistic approach that prioritizes sustainable land use practices, promotes traditional farming systems, and fosters agricultural diversity essential for food security and environmental resilience.

Conservation of Agrobiodiversity: Approaches and Strategies

Conservation of agrobiodiversity encompasses a range of approaches and strategies aimed at safeguarding the genetic diversity of agricultural crops and related species, both within their natural habitats (in situ) and outside of them (ex situ), as well as through ecosystem-level conservation efforts. Ex Situ Conservation involves preserving genetic resources outside their natural habitats, typically in controlled environments like seed banks, gene banks, and living collections (Dulloo *et al*., 2010). Seed banks play a crucial role in conserving diverse crop varieties and wild relatives by storing seeds under optimal conditions, ensuring their availability for future use. Maintaining genetic diversity in ex situ collections is vital for protecting against

genetic erosion caused by factors like climate change. Global initiatives like the Svalbard Global Seed Vault and national gene banks contribute significantly to ex situ conservation efforts (Ray *et al.*, 2021). In Situ Conservation focuses on conserving genetic resources within their native habitats. On-farm conservation involves farmers preserving diverse crop varieties and livestock breeds through traditional farming practices and seed-saving techniques. Community seed banks empower local communities to manage and conserve agrobiodiversity collectively. Conservation efforts also target wild relatives of cultivated crops, ensuring their survival within native ecosystems to maintain genetic diversity (Bellon *et al*., 2017). Ecosystem-Level Conservation integrates biodiversity conservation with sustainable agricultural practices. Agroecological approaches like agroforestry and integrated pest management promote biodiversity while supporting agricultural productivity. Diverse agroecosystems provide essential ecosystem services such as pollination, soil fertility, pest regulation, and water retention. Conservation agriculture techniques minimize soil disturbance and promote crop diversity, enhancing agrobiodiversity and ecosystem resilience. Landscape-level planning strategies aim to protect and connect diverse habitats, promoting agrobiodiversity across larger geographical scales. A comprehensive approach to conserving agrobiodiversity involves a combination of ex situ and in situ conservation methods, along with ecosystem-level strategies that integrate biodiversity conservation with sustainable agricultural practices. By implementing these approaches, we can ensure the preservation of genetic resources essential for future food security and environmental sustainability (Liu *et al*., 2022).

One of the most remarkable examples of agricultural biodiversity in India is exemplified by the traditional practice of baranaja, meaning '12 grains', once common in the Garhwal Himalaya region. This unique farming method involves intercropping a diverse mixture of crops within a single plot of land, including Wheat, Barley, Peas, Lentils, Chickpeas, Mustard, Sesame, Fenugreek, Linseed, Coriander, Cumin, and Fennel. Each crop contributes distinct nutritional, ecological, and cultural values to the farming system. The baranaja system is notable for its ability to enhance soil fertility naturally through methods like crop rotation and diverse cropping, which effectively manage pests and diseases without the need for chemical interventions, thereby promoting ecological balance. The diversity of crops grown in baranaja ensures food security by providing a varied and nutritious diet for farming households, reducing dependency on single crops and offering resilience against food shortages. Moreover, it supports climate resilience by adapting well to changing environmental conditions and mitigating risks associated with climate-related challenges such as drought or erratic rainfall. This agricultural practice also promotes income diversification for farmers, enabling multiple sources of revenue from different crops throughout the year. Importantly, baranaja farming preserves local culture and traditions, serving as a symbol of cultural identity and heritage among tribal communities in the region. By maintaining diverse agrobiodiversity, this farming system contributes to environmental conservation by preserving natural resources, promoting soil health, and supporting ecosystem balance (Gururani *et al*., 2021).

Cheruvayal Raman's story highlights another inspiring example of agrobiodiversity conservation in India, specifically focused on the preservation of native rice varieties. Known as India's "living paddy gene bank" and the "Guardian of Native Paddy," Raman has devoted the past two decades of his life to conserving 54 ancient types of rice varieties in Kerala's Wayanad region. Despite being 72 years old, he remains committed to this critical mission. In Wayanad, traditional farming practices once included the cultivation of diverse indigenous rice varieties. However, with the advent of high-yielding and genetically modified seeds, many farmers shifted away from these native varieties, putting them at risk of extinction. Varieties like Jeerakasala, Pokkali, Chomala, and Navara became less cultivated, threatening the genetic diversity of local rice crops. Cheruvayal Raman's efforts have been instrumental in preserving and propagating these endangered rice varieties. By safeguarding these native seeds, he contributes to maintaining agrobiodiversity, which is crucial for ecological resilience, food security, and cultural heritage preservation. These traditional rice varieties are adapted to local environmental conditions, possess unique flavors and nutritional profiles, and often exhibit resilience to pests and diseases. Raman's work not only protects genetic resources but also empowers local farmers to reclaim their agricultural heritage. By promoting the cultivation of native rice varieties, he supports sustainable farming practices that prioritize biodiversity conservation over monoculture approaches reliant on high-input modern agricultural techniques. This conservation initiative underscores the importance of traditional knowledge and indigenous practices in maintaining agrobiodiversity amidst global agricultural trends favoring uniformity and commercialization. His dedication serves as a testament to the critical role individuals can play in preserving agrobiodiversity and ensuring the resilience of our food systems in the face of environmental challenges and shifting agricultural paradigms. His efforts resonate as a beacon of hope for

sustainable agriculture and cultural continuity, emphasizing the value of local knowledge and community-based conservation approaches in safeguarding our agricultural heritage for future generations (www.thebetterindia.com).

The Vital Role of Ethnobotany: Bridging Traditional Plant Knowledge with Contemporary Challenges

Ethnobotany is a multidisciplinary field that integrates traditional ecological knowledge, plant taxonomy, anthropology, and pharmacology, among others, to study the relationships between people and plants. The applications of ethnobotany span various domains and have significant impacts: In Medicine and Healthcare, ethnobotany plays a crucial role in discovering new medicinal plants and validating traditional plant-based remedies. By studying indigenous healing practices, ethnobotanists identify potential sources of new drugs and therapies, contributing to advancements in healthcare. In the words of the Declaration of Kaua'I (Prance, 2007): "Ethnobotany can strengthen our links to the natural world. It makes it possible for us to learn from the past and from the diverse approaches to plants represented by the different human cultures that exist today. Ethnobotany is at once avital key to preserving the diversity of plants as well as to understanding and interpreting the knowledge by which we are, and will be, enabled to deal with them effectively and sustainably throughout the world. Thus, ethnobotany is the science of survival". Ethnobotanical knowledge encompasses a wide range of edible plants, including traditional crops, wild food, and culinary herbs. Utilizing ethnobotanical resources can enhance food security, promote dietary diversity, and support sustainable agriculture. Ethnobotanical knowledge is closely linked to cultural identity, traditions, and rituals. Ethnobotany provides a rich interdisciplinary field for education and research. Utilizing ethnobotanical resources can enhance academic curricula, providing students with opportunities to learn about plant biology, ecology, anthropology and indigenous knowledge systems. Ethnobotanical resources offer economic opportunities for indigenous and local communities through sustainable resource management, eco-tourism, and value-added products. Utilizing ethnobotanical knowledge can support community-based enterprises, promote indigenous entrepreneurship, and generate income from the sustainable use of plant resources. Traditional farming practices often incorporate a diverse range of crops and agroforestry techniques that enhance soil fertility, pest management, and resilience to climate change.

Conservation and sustainable use benefit from ethnobotanical research, which helps prioritize species for conservation based on their cultural and ecological importance. This fosters sustainable use practices that preserve biodiversity and traditional knowledge (Pei *et al.*, 2020). Food and Nutrition are enhanced by ethnobotanical studies that promote the diversification of diets through the reintroduction of nutritious native crops. By understanding traditional food plants and their nutritional values, ethnobotany informs efforts to enhance food security and combat malnutrition. Economic Development is supported by the herbal industry, utilizing medicinal plants for pharmaceuticals, cosmetics, and herbal supplements. Ethnobotany also drives eco-tourism and cultural enterprises cantered around traditional plant knowledge and practices, contributing to local economies Environmental and Ecological Applications benefit from ethnobotanical insights that inform agroecological practices and sustainable agriculture methods. By integrating traditional farming techniques with modern approaches, ethnobotany supports ecological restoration efforts by identifying native plants for habitat restoration and land management. Education and Cultural Preservation are promoted by ethnobotany through the preservation and promotion of cultural heritage tied to plant-based rituals, stories, and traditions. This field fosters interdisciplinary studies that bridge scientific knowledge with indigenous wisdom, promoting mutual respect and understanding.

Overall, ethnobotany's recognition of the value of traditional plant knowledge contributes to sustainable development and the well-being of communities worldwide by addressing contemporary challenges in healthcare, conservation, food security, economic development, environmental stewardship, education, and cultural preservation.

Harmony of Agrobiodiversity and Ethnobotany: Sustaining Plant Diversity and Traditional Knowledge

Agrobiodiversity and ethnobotany are intricately linked disciplines that underscore the profound relationship between plant diversity and traditional knowledge within diverse communities. The intersection of these fields involves the utilization of both cultivated and wild plant species for various purposes such as food, medicine, fiber, fuel, and in cultural practices. Indigenous and local communities have amassed extensive knowledge about plant properties and uses over generations, contributing to the preservation and sustainable utilization of diverse plant resources. Ethnobotanical studies are instrumental in identifying valuable plant traits and traditional crop varieties, aiding in their conservation and sustainable use (Whitney *et*

al., 2018). Documenting and understanding local knowledge about plants is crucial for maintaining genetic diversity and adapting to changing environmental conditions. Sustainable farming practices promoted through agrobiodiversity initiatives, such as mixed cropping, crop rotations, intercropping, and agroforestry, integrate diverse plant combinations and management techniques to enhance soil fertility, pest management, and overall ecosystem resilience while supporting traditional agricultural systems. The nutritional value of traditional food plants is paramount for food security and dietary diversity, addressing nutritional challenges within communities. Traditional food systems often incorporate a wide range of locally adapted crops and wild edibles, providing essential nutrients and fostering health and well-being. Moreover, plants hold deep cultural significance, influencing traditional farming practices, plant-based rituals, and cultural heritage. Ethnobotanical research emphasizes the importance of preserving cultural connections to plants and understanding their role in shaping community identity and values (Kuhnlein and Chotiboriboon, 2018). Ethnobotany contributes to community engagement and empowerment by promoting food sovereignty, preserving cultural identity, and enhancing livelihood resilience. Empowering local communities to manage and benefit from their plant resources strengthens social cohesion and supports sustainable development goals. By integrating traditional knowledge with modern conservation and agricultural practices, these disciplines play a crucial role in biodiversity conservation, food security, cultural preservation, and community empowerment across diverse socioecological contexts (Radha *et al*., 2012).

Adding Value to Crops: Enhancing Quality, Nutrition, and Market Potential

Enhancing the value of crops involves a comprehensive and strategic approach encompassing processing, preservation, quality enhancement, nutritional enrichment, diversification, and sustainable practices. Processing methods such as milling grains into flour, canning fruits and vegetables, extracting oils from seeds, drying herbs and spices, and fermenting fruits into beverages transform raw agricultural produce into market-ready goods with extended shelf life and enhanced market potential (Ricachenevsky *et al*., 2019). Preservation techniques like freezing, drying, and canning play a vital role in extending the availability of perishable crops beyond the harvest season, reducing post-harvest losses, and ensuring consistent product supply. Quality enhancement is achieved through standardization, ensuring uniformity in size, color, texture, taste, and nutritional content, while certification verifies these attributes to meet stringent market demands. Nutritional enhancement strategies, including fortification with essential nutrients like vitamins and minerals and processing methods that improve the bioavailability and digestibility of nutrients, not only boost the nutritional value of crops but also contribute to consumer health and wellness (Ikegwu *et al*., 2022).

Diversification and innovation are key drivers of value addition in crop production (Barman *et al.*, 2022). The creation of new products from crops such as processing soybeans into tofu, soy milk, soy sauce, and textured vegetable protein, or corn into starch, oil, snacks, and animal feed expands market opportunities and enhances profitability. Moreover, utilizing by-products to create value-added products, such as using fruit peels for animal feed or biogas production, minimizes waste and maximizes resource efficiency. Effective branding and marketing strategies play a crucial role in differentiating value-added agricultural products in the market, enabling them to command premium prices and gain consumer trust and loyalty. Furthermore, adopting sustainable practices, such as utilizing crop residues for animal feed, bioenergy production, or composting, aligns with circular economy principles, reducing waste and environmental impact while enhancing overall sustainability in agriculture (Khan *et al.*, 2022). This holistic approach not only enhances the quality, nutrition, and market potential of crops but also fosters innovation and sustainability throughout the agricultural value chain. By integrating these strategies, farmers and producers can maximize the value of their crops, meet evolving consumer preferences, and contribute to a more resilient and sustainable food system.

CCS HAU's Role in Agrobiodiversity Conservation: Promoting Diversity for Sustainable Agriculture

Chaudhary Charan Singh Haryana Agricultural University (CCSHAU) stands as one of the largest agricultural universities in Asia, situated in Hisar, Haryana, India. Named in honour of India's seventh Prime Minister, Chaudhary Charan Singh, this university has been a pioneering force in agricultural research within India. Notably, HAU played a pivotal role in India's agricultural advancements during the 1960s and 70s, contributing significantly to both the Green Revolution and White Revolution. These movements transformed agricultural practices in India, boosting productivity and enhancing dairy production respectively (https://hau.ac.in/).

The primary campus of the University is located in Hisar, approximately 190 km northwest of Delhi along National Highway No. 9. It is conveniently situated 2.5 km from the Hisar Railway Station and 3 km from the Bus Stand. The University spans a total area of 6084 acres in Hisar and an additional 1424 acres across outstations. Within the Hisar campus, 6428 acres are dedicated to agricultural farms, while 736 acres are allocated for buildings and roads. Over the years, the University has made significant advancements in building construction, resulting in an excellent infrastructure.

CCS HAU plays a crucial role in promoting agrobiodiversity conservation and sustainable agriculture through several key initiatives. The university has contributed significantly to developing diverse crop varieties, including both indigenous and traditional varieties, which not only preserve genetic diversity but also cater to specific regional and market demands. By releasing numerous crop varieties and hybrids, CCS HAU supports resilience in agricultural systems and provides farmers with options suited to varying agro-climatic conditions. In addition to developing new varieties, the institution actively conserves germplasm, ensuring the availability of genetic resources for future breeding programs, research endeavours, and addressing emerging agricultural challenges. This approach safeguards valuable genetic material that can be used to enhance crop traits such as yield, disease resistance, and nutritional content.

The university's research extends to traditional farming systems and agroecological practices, promoting sustainable agriculture. CCS HAU emphasizes agroecological techniques like organic farming, agroforestry, and integrated pest management, which reduce reliance on synthetic chemicals and foster biodiversity conservation. These practices not only contribute to soil health and ecosystem resilience but also minimize environmental impacts associated with conventional agriculture. Furthermore, it actively promotes organic farming methods, which prioritize biodiversity conservation and emphasize the use of natural inputs over synthetic chemicals. By advocating for organic farming practices, the university supports sustainable agriculture and encourages farmers to adopt environmentally friendly approaches that enhance the overall health of agroecosystems. Moreover, CCS HAU promotes agroecological practices such as intercropping, cover cropping, and integrated pest management, which contribute to enhanced biodiversity on farms. These practices create more complex and resilient agroecosystems, improving soil fertility, reducing erosion, and providing habitat for beneficial organisms. Through these efforts, the university plays a pivotal role in advancing sustainable agriculture and preserving agrobiodiversity for future generations.

CCS HAU's Contributions: Varietal Innovations in Crop Plants, Vegetables, and Horticultural Crops

The release of a diverse range of crop varieties, vegetables, forage crops, and horticultural species by CCS HAU (Chaudhary Charan Singh Haryana Agricultural University) underscores its commitment to supporting agrobiodiversity. Up to September 2023, CCS HAU has introduced an impressive array of new varieties across various crop categories. This includes 23 wheat varieties, 8 barley varieties, 11 rice varieties, 22 pearl millet varieties, 29 maize varieties, and 31 oilseed varieties. Additionally, CCS HAU has released 35 pulse crop varieties, 23 cotton varieties, 8 sugarcane varieties, 47 forage crop varieties, 10 medicinal and aromatic plant (MAP) varieties, 33 vegetable varieties, and 4 horticultural varieties (Directorate of Research, CCSHAU, Hisar).

The introduction of such a broad spectrum of crop and plant varieties serves several important purposes (Table 1) (Directorate of Research, CCSHAU, Hisar). First, it contributes significantly to agrobiodiversity, which is essential for maintaining resilient agricultural systems capable of adapting to changing environmental conditions and evolving pest and disease pressures. These new varieties also address specific challenges faced by farmers, such as improving yield potential, enhancing resistance to pests and diseases, and adapting to local climatic conditions. Moreover, the release of diverse vegetable and horticultural varieties promotes dietary diversity and nutrition security by offering a wider range of nutritious food options to consumers. This diversity not only enriches the culinary landscape but also supports local economies by providing opportunities for niche markets and value-added products. By actively promoting and disseminating these new crop varieties, CCS HAU contributes to the conservation and sustainable use of agrobiodiversity, ultimately supporting the long-term resilience and productivity of agricultural systems. Furthermore, these efforts align with broader goals of ensuring food security, promoting sustainable agriculture, and fostering innovation in crop production and horticulture.

Table 1: Varieties Released by CCS HAU

Crops	Varieties released
Wheat	WH 1270, WH 1184, WH 1142, WH 1124, WHD 948, WH 1105, WH 1080, WHD 943, WH 1025, WH 1021, WH 711, WH 912, SONAL, WH 896, WH 533, WH 542, WH 516, WH 291, WH 283, WH 147, WH 157, and C 306.
Barley	BH 959, BH 946, BH 885, BH 902, BH 393, BH 75, BG 25, and BG 105.
Maize	HM 13, HM 12, HSC 1, HM 11, HM 10, HM 9, HM 8, HM 5, HM 4, HHM 2, HHM 1, HQPM 4, HQPM 7, HQPM 5, and HQPM 1.
Rice	Haryana Basmati 2, HKR 128, HKR 48, HKR 127, Haryana Shankar Dhan 1, HKR 47, HKR 46, HKR 126, Taraori Basmati, Haryana Basmati, and HKR 120.
Cotton	HS 292, H 1353, H 1300, H 1098-i, H 1236, H 1226, H 1117, H 1098, HS 6, H 974, HS 45, H 655C, H 777, HHH 287, HHH 223, HHH 81, HD 432, HD 324, HD 123, HD 107, DS 5, and DS1.
Sugarcane	CoH 128, CoH 110, CoH 119, CoH 92, CoH 56, CoH 99, and CoH 35.
Oilseeds	RH 761, RH 725, RH 0749, RH 0406, RH 0119, RB 50, RB 24 (RB 9901), Swaran Jyoti (RH 9801), VASUNDHRA (RH 9304), LAXMI (RH 8812), RH 781, RH 819, SAURABH (RH 8113), TH 68, SANGAM, T 27, HT 2, HT1, CH 1, HSFH 848, HARYANA SURAJMUKHI 1, YSH 0401, YSPb 24, BSH 1, MH 4, MH 2, and MH 1.
Pulses	HK 4, HK2, HK1, HC 7, HC5, HC1, GORA HISARI, GAURAV, H 208, H 355, C 235, HFP 1428, HFP 715, HFP 529, HFP 9426, Hariyal, Jayanti, Uttara, Aparna, Garima sapna, MH 1142, MH 318, MH 421, Basanti, Sattya, Muskan, Asha, Paras, and Manak.
Vegetable Crops	Bitter Gourd, Onion, Bottle Gourd, Brinjal, Cauliflower, Garlic, Okra, Fenugreek, Coriander, Indian Melon, Indian Besan, Tomato, Carrot, Long Melon, Radish, And Vegetable Peas.
Forage Crops	Barseem, Oats, Sorghum, Cowpea, Cluster Bean, Senji, Methi (Fenugreek), And Lucerne.
Medicinal and Aromatic Plants	Fababean, Dhaincha, Isabgol, Mulhatti, Rosgagrass, Periwinkle, And Guayule.
Horticulture	Marigold (Hisar Jaffri-2 and Hisar Beauty) Guava (Hisar Safeda and Hisar Surkha)

CCS HAU has achieved significant milestones in agricultural advancements through the release of pioneering crop varieties. Notably, in the domain of wheat, varieties such as WH 283, known for its excellent chapatti-making quality, and C 306, a desi variety requiring low inputs, showcase the university's commitment to addressing diverse agricultural needs. For sugarcane, the release of CoH 119, specifically for spring planting, reflects innovative approaches to crop management and production timing.

For rice, it has introduced Taraori Basmati, a widely adapted variety prized for its high aroma, and HKR 47, which is a semi-dwarf, non-scented variety characterized by long, slender grains. These rice varieties demonstrate the university's focus on developing diverse options that cater to different market demands and environmental conditions. Furthermore, CCS HAU has made notable advancements in hybrid crop development. The release of HHB 67 Improved, a hybrid bajra (pearl millet) involving male parent development through Marker Assisted Selection, underscores the university's expertise in modern breeding techniques. In the realm of cotton, the university achieved a significant milestone by developing AAH1, India's first cotton hybrid, setting a precedent for enhanced cotton cultivation practices. In maize, HM 4 was introduced, the first baby corn hybrid in India, demonstrating innovation in crop diversification and specialized product development. These landmark varieties not only showcase the university's dedication to

agricultural research and development but also pave the way for improved productivity, quality, and sustainability in Indian agriculture (Directorate of Research, CCSHAU, Hisar).

CCS HAU's Initiatives

Deendayal Upadhyay Centre of Excellence for Organic Farming

Establishment of the "Deendayal Upadhyay Centre of Excellence for Organic Farming" at Chaudhary Charan Singh Haryana Agricultural University, Hisar marks a significant initiative aimed at promoting organic farming within the state. The center, sprawling across 139 acres of land, is designed to train farmers in organic farming techniques as incubatees. Farmers receive comprehensive scientific knowledge on organic farming practices, including aspects of marketing, storage, and post-harvest technology. The organic produce cultivated at this center will be directly marketed in Delhi and the National Capital Region (NCR). Notably, this pioneering center will also develop recommendations for organic farming practices, which will be shared with farmers for implementation on their own farms.

Agri-Tourism Center

The Agri-tourism Center features a captivating Botanical Garden spreading over 10.5 acres of land, meticulously curated and maintained by the Department of Botany and Plant Physiology. This botanical oasis boasts an impressive collection of over 550 indigenous and exotic plant species, making it a hub for academic research and a magnet for visitors from across Haryana. Each year, numerous schools and colleges send students to explore the Botanical Garden, where they receive insightful guidance on plant biodiversity from esteemed professors and scientists within the department. The garden also attracts renowned personalities and government officials, highlighting its significance as a cultural and educational landmark. A standout event hosted by the garden is the annual Chrysanthemum show, drawing approximately 10,000 visitors over two days. This vibrant showcase generates substantial interest, with chrysanthemum sales reaching up to one lakh rupees. The event invites public participation in various competitive categories, including potted chrysanthemums, foliage plants, palms, cacti, succulents, marigolds, and fresh flower arrangements. Additionally, on-the-spot drawing and painting competitions, mehndi-rachao contests, and rangoli competitions cater to diverse age groups of students, enriching the event's appeal and fostering community engagement. Exciting developments are underway, including the creation of a Bamboosetum featuring seven species sourced from Pantnagar, with plans to expand the collection further. The garden also operates a nursery, providing disease-free plants to residents of Hisar and beyond. Currently equipped with two glass houses, five ponds, and a green house, the Botanical Garden serves as a dynamic hub for botanical exploration, education, and horticultural innovation, enriching the local landscape and nurturing a deeper appreciation for plant diversity.

Krishi Mela

The Krishi Mela organized by CCS HAU in Hisar is a flagship agricultural event that brings together farmers, researchers, policymakers, and agricultural enthusiasts from across the region. The Krishi Mela serves as a platform for showcasing the latest advancements in agriculture, disseminating knowledge, and promoting sustainable farming practices. Its extensive demonstration plots showcasing innovative farming techniques, crop varieties, and agricultural machinery. These plots provide farmers with practical insights into modern agricultural practices and technologies. The event hosts informative workshops and seminars conducted by experts and scientists. Topics covered include crop management, soil health, water conservation, pest control, organic farming, and climate-resilient agriculture. Farmers gain valuable knowledge and strategies to improve their farming practices. The Krishi Mela hosts a diverse array of exhibitor stalls representing agricultural companies, government agencies, research institutions, and NGOs. Exhibitors showcase agricultural inputs, equipment, seeds, fertilizers, pesticides, and organic products. Farmers can explore and procure cutting-edge agricultural technologies and products. Livestock exhibitions featuring cattle, buffalo, sheep, and poultry breeds are a highlight of the Krishi Mela. The event facilitates the distribution of high-quality seeds, planting materials, and saplings of improved crop varieties to farmers. Agricultural machinery demonstrations allow farmers to witness the performance of modern farm equipment such as tractors, harvesters, seeders, and irrigation systems. Farmers can make informed decisions about investing in suitable machinery for their operations. It serves as a catalyst for agricultural development and rural prosperity by fostering collaboration, innovation, and capacity-building in the farming community.

Promoting Societal Awareness through Outreach Programs

CCS HAU actively promotes societal awareness through its comprehensive outreach programs, which include organizing international conferences, fostering international collaborations, and conducting seminars, workshops, and trainings on a regular basis (Table 2). These initiatives serve as platforms for knowledge exchange, capacity building, and networking among stakeholders in the agriculture and allied sectors. By hosting international conferences, CCS HAU facilitates discussions on cutting-edge research and global trends in agriculture, providing a forum for experts and practitioners to share insights and best practices. Collaborations with international partners enable the university to leverage diverse expertise and resources, fostering innovation and addressing shared challenges in sustainable agriculture and food security. Furthermore, CCS HAU's seminars, workshops, and trainings cater to diverse audiences, including farmers, students, researchers, and policymakers, aiming to disseminate scientific knowledge, promote skill development, and raise awareness about emerging issues and technologies in agriculture. Through these outreach efforts, CCS HAU contributes to building a knowledge-driven society and advancing sustainable agricultural practices on a global scale (https://hau.ac.in/).

Table 2: International Conferences, Collaborations, and Capacity-Building Initiatives at CCS HAU

INTERNATIONAL CONFERENCES • International Conference on Climate Resilient Agriculture for Food Security and Sustainability. February 17-19, 2023. • International year of millets, International Conference on Strategies for global food and nutritional security, sustainability and wellness (NUTRI-2023). December 04-06, 2023. • International Symposium on Innopreneurship: A need of Sustainable Agriculture, February 2-3, 2019.
INTERNATIONAL COLLABORATIONS • Nine research projects with international collaboration viz. ACIAR-Australia, CIMMYT-Mexico, DFID-UK, RWC-CIMMYT, RWC-USAID, ADB-IRRI, ACIAR-Australia
SEMINARS/ WORKSHOPS/TRAININGS • Silver Jubilee Group Meeting of AICRP on Vegetable Crops held from May 16-19, 1983. • AICRP (Potato) Workshop" held in 1982 at HAU, Hisar. • National Symposium on Advances in Research and Development in Horticulture for Export held at CCS HAU, Hisar in 1995. • Silver Jubilee National Symposium on Arid Horticulture held at CCSHAU, Hisar in 1996 • Silver Jubilee Group Meeting of AICRP on Vegetable Crops held at CCS HAU, Hisar May 3-6, 2007. • National seminar on "Recent Trends in Research on Spices and Aromatic Plants held from 10-12 September 2008. • The Department of Vegetable Science in collaboration with Directorate of Arecanut and Spices Development, Calicut (Kerala) organized Annual Review Meeting of Mission for Integrated Development of Horticulture (MIDH) Programme on Spices–2017 during May 12-13, 2017 • MHU Karnal and CCS HAU, Hisar organized Horticultural Officers Workshop-2017 in May 18, 2017 at CSSRI- Karnal • Chaudhary Charan Singh Haryana Agricultural University organized a workshop on ashwagandha • Training on life skills • Trainings on Stress management • Trainings on Mushroom cultivation • Vocational training on basic course of hair and skin care" • Vocational training on basic course of "computer application" • Vocational training on "Cutting and tailoring".

Conclusion

Agrobiodiversity stands as a critical component of our agricultural and ecological heritage, enriched over millennia by the stewardship of farmers, breeders, and indigenous communities. The diverse genetic resources embedded within agrobiodiversity not only sustain our food systems but also hold immense cultural and ecological value. However, the ongoing degradation of agrobiodiversity in India underscores urgent challenges stemming from urbanization, deforestation, agricultural modernization, and shifting consumption

patterns. These trends threaten the rich tapestry of genetic diversity and traditional knowledge essential for resilient and sustainable agriculture. Efforts to conserve agrobiodiversity must embrace a holistic approach, combining in situ and ex situ conservation methods alongside ecosystem-level strategies. Moreover, integrating agroecological practices with sustainable agriculture not only fosters biodiversity but also enhances ecosystem resilience and supports food security. The rich agrobiodiversity maintained and studied at HAU serves as a valuable resource for ethnobotanical research. This research investigates traditional ecological knowledge associated with various plant species, exploring their uses in medicine, food, rituals, and other cultural practices. By studying the relationships between people and plants, ethnobotanists at HAU contribute to the preservation of indigenous knowledge and the sustainable utilization of agrobiodiversity. Initiatives like those spearheaded by CCS HAU exemplify the commitment needed to preserve agrobiodiversity through the development and promotion of diverse crop varieties suited to diverse agro-climatic conditions. Ultimately, safeguarding agrobiodiversity is imperative for ensuring food security, adapting to climate change, and fostering sustainable agricultural systems that resonate with cultural diversity and ecological integrity. By valuing and conserving agrobiodiversity, we honor our shared heritage and pave the way for a more resilient and equitable food future.

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Advancing Agriculture by Harnessing Smart Technologies for Sustainable Farming

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Abstract

Farmers are increasingly drawn to smart agriculture methodologies, spurred by various factors, including the widespread availability of affordable, low-power Internet-connected sensors. These sensors enable remote monitoring and reporting of crop, weather, and field conditions, facilitating more efficient resource management, such as reduced pesticide usage and optimized irrigation practices. Additionally, the integration of autonomous farming equipment and advanced data analytics powered by artificial intelligence aids in disease and pest control while enhancing forecasting accuracy through historical data analysis. These technological advancements mark a significant departure from traditional agricultural practices. The future trajectory of Climate Smart Agriculture is poised to leverage state-of-the-art internet technologies for securing agricultural data, refining cropping strategies and management techniques, offering integrated "internet + weather" services, elevating agricultural service standards, and implementing weather index-based insurance systems.

Keywords: Internet technology, farming advancement, Climate Smart Agriculture, Mobile technology.

Introduction

Decades of meteorological data have unequivocally illustrated the scientific reality of global warming (IPCC, 2014). Human-induced greenhouse gas emissions are steadily elevating the Earth's average temperature, precipitating profound shifts in global climate patterns (Lipper et al., 2014; IPCC, 2018). Amidst this environmental backdrop, food security emerges as a paramount concern, essential for the sustained existence of humanity. While agricultural practices have evolved over millennia, traditional farming methods alone prove insufficient to meet the burgeoning demand for food (Miflin, 2000). Compounded by the rapid expansion of economies and populations in emerging nations, the imperative to enhance agricultural productivity becomes increasingly urgent. For many food-insecure households, agriculture forms the backbone of their livelihoods, underscoring its pivotal role in economic growth and job creation.

In response to these challenges, novel strategies are imperative to bolster both the quantity and quality of agricultural yields. Modern agricultural technologies hold the promise of substantially enhancing sustainability and productivity. Best management practices, including biological pest control, disease-resistant hybrids, reduced pesticide usage, and innovative cultural methods, represent crucial avenues for mitigating pest and disease incidence. The advent of biotechnology heralds new frontiers in agricultural science, offering the potential to develop resilient crop varieties capable of withstanding the rigours of climate change. Leveraging advancements in genomics, stress biology, and bioinformatics, scientists endeavour to engineer stress-tolerant crops, thus fortifying global food security in the face of mounting environmental pressures (Rashid et al., 2017).

Modern agricultural technology for future agriculture

Crop sensor

Crop sensors represent a transformative leap in agricultural technology, empowering farmers to optimize fertilizer application with unprecedented precision. Farmers can gauge crop health in real-time by harnessing these sensors, minimizing fertilizer runoff and leaching into groundwater. This paradigm shift marks the evolution of variable rate technology, enabling application equipment to dynamically adjust fertilizer dosage without the need for pre-established prescription maps. Leveraging optical sensors, which assess the amount of light reflected by plants, these cutting-edge tools calculate the precise fertilizer requirements of individual crops, thereby maximizing fertilizer uptake while minimizing environmental impact.

Table 1: Use of smartphone sensors in advanced agriculture (Source: Khan et al., 2021).

Smartphone Sensors	Purpose	Common Agriculture Usages
Image sensor (Camera)	Take images of any object	Leaf area index (LAI), fruit ripeness, harvest readiness, soil erosion, disease detection.
Accelerometer	Measures acceleration that used to observe the tilting motion and orientation of the object	Rotation of camera during use, machine activities, or detecting workers.
GPS	Provides location, measuring the latitude and longitude of devices	Used for location information, land measurement, and crop mapping
Microphone	Detects usual or unusual sound and transform into electrical waves	Maintenance of machine, detection of bugs, and making audio queries.
Gyroscope	Senses the angular velocity to track the target rotation/turn	Canopy structure measurement and equipment movement.
Inertial Sensor	Utilizes accelerometer and gyro to determine the object altitude in relation to the inertial system	The precise distance of the plant, leaves, and/or any other object is measured from the camera.
Barometer	Measure air pressure	Measure air pressure

Usage of Mobile Technology and Cameras

Farmers and ranchers use social media for a variety of purposes, and mobile technology and cameras are important tools in this regard. Some people use apps like Foursquare to monitor their staff members. Installing cameras throughout the farm is becoming more and more popular. Cameras in barns, feedlots, and pastures are being wired by livestock managers to transmit footage to a central point, such as a home computer or office. When animals are gone or spending the night at home, they can monitor them more closely. Many nations, including China, Turkey, India, and several African countries, adopt smartphone technology. These nations are employing this cutting-edge technology to raise agricultural output and strengthen their economies (Rehman et al., 2017).

Table 2: Some significant smartphone applications generated for numerous agricultural approaches, as well as their functions and applications (Source: Khan et al., 2021)

Mobile Apps	Application	Feature/Achievement
PETAFA	GIS	It provides information on the normalized difference vegetation index (NDVI) for different crops at various life cycles. However, it distributes geo-referenced soil analysis through packages.
Land PKS	Soil Assessment	Land management has long-term potential, depending on weather, topography, and relatively static soil properties (such as depth, soil texture, and mineralogy). The app aims to increase growers' understanding of the land potential and climate change adaptation and mitigation activities.
PocketLAI	Irrigation	The app estimates the leaf area index (LAI), which is the main factor determining plant water requirements. It uses a moving camera and accelerometer sensor to acquire images at 57.5° under the hood while the user keeps rotating the device along its central axis.

AMACA	Machinery or Devices	Equipment costs are a significant part of crop expenditure. The application helps estimate the mechanical and implantation costs in different field operations. Follow the cutter-driven quality function deployment (QFD) approach to meet your expectations with user expectations for application design features.
eFarm	GIS	eFarm is crowdsourcing and human perception tool that collects geo-tagged agricultural land information at the parcel level. Ideal for mapping, sensing, and modeling of agricultural land systems research.
AgriMaps	Land Management	The application follows an evidence-based, site-specific approach to make recommendations for cropland management. Compared to other related applications, it provides a platform for spatial data visualization with a wider range of geospatial information.
Weedsmart	Weed Management	This app can increase weed management in the pasture. Based on the answers given to nine questions about pasture farming systems, this application assesses herbicide resistance and the risk of weed seed banks.
Village Tree	Pest Management	Village Tree provides smart pest management solutions by collecting plant pest and disease reporters. It uses a crowdsourcing method and sends images along with location knowledge to warn other growers that may be affected.
cFertigULF	Fertigation	The tool measures the amount of fertilizer and water required for major crop types based on different crop growth systems and multiple fertilization techniques. Farmers can achieve the precise application of water and other nutrients in greenhouse farming.

Application of Artificial intelligence (AI)

Future CSA directions include the application of artificial intelligence. Artificial intelligence (AI) is the simulation, extension, and expansion of human intelligence through the use of digital computers or other controlled technologies to sense the environment and gather pertinent information. AI has already proven to have several benefits in a variety of industries. The most recent developments in big data and computer hardware have made room for the use of AI in agriculture. AI is being utilized in many agricultural industries to perform tasks including plant recognition, weed prediction, crop yield prediction, climate prediction, GHG emissions forecasting, pest control, and risk assessment of crop planting. AI can evaluate and integrate data from various agricultural domains (Jha et al., 2019; Hamrani et al., 2020).

Biotechnology

Although genetic engineering (GE) and biotechnology are not new technologies, they are significant technologies with a lot of untapped promise. Herbicide resistance is a type of genetic engineering that most people have undoubtedly heard of. It is possible to engineer crops to express poisons that suppress specific pests. A toxin used by many is the same toxin present in certain organic insecticides. It implies that a farmer won't need to cross his fields in order to apply pesticide, saving not just on pesticide but also on labour, fuel, and equipment wear. An alternative perspective is that farmers who employ irrigation can reduce water usage without experiencing a decline in crop output. That is similar to nitrogen use efficiency, but you utilize fertilizer rather than water (Rehman et al., 2017).

Plant tissue culture in crop improvement

Plant tissue culture is an innovative in vitro technology that has facilitated the development of numerous new methods to support plant breeders. Somaclonal variations are alterations brought about by plant tissue

culture. Plant tissue fragments will gradually split, creating a colourless clump of cells known as a callus. The process of creating a new plant from plant tissues begins with the callus (Jain, 2001). Utilizing plant tissue culture, genetic diversity has been developed that can be used to improve crop plants. Desired genetic and commercial features have been transferred through the use of tissue culture in conjunction with molecular approaches.

Nanotechnology in Crop Improvement

A new, illuminating, broad field of science called nanotechnology deals with creating, modifying, and using materials at the molecular level on a nanoscale scale. Agriculture is just one of several scientific fields that have instances in this wide-ranging, rapidly developing field (Ali et al., 2014b). The application of these nanoparticles has been shown to improve germination, increase the vegetative biomass of seedlings in numerous crops, and lengthen roots and shoots. Enhancement in numerous physiological indicators, such as photosynthetic activity and nitrogen metabolism, has been documented in multiple crops, such as peanuts, spinach, and soybeans.

Bioinformatics tools in crop improvement

These days, crop enhancement through the use of bioinformatics technologies appears more promising. The level of technological advancement over time has been astounding. Bioinformatics is a technology that explores the sequences of many genes and supplies essential information about the genomic data of crops. This might make it easier for us to identify the features that are more advantageous and the corporations that are significant economically. The rate of proficient research is increasing due to whole genome comparisons.

Current challenges and future perspectives

The journey of agricultural progress is riddled with challenges, from dwindling labour forces and diminishing arable land to water scarcity and the impacts of climate change. As rural populations age and urbanization accelerate worldwide, the mantle of responsibility falls increasingly on the shoulders of young farmers. Population imbalances and generational transitions portend significant shifts in on-farm management and the availability of agricultural labour in rural areas. Moreover, while arable land dwindles, environmental and geographical constraints limit the suitability of many sites for crop cultivation. Climate change further compounds these challenges, exerting its effects across a spectrum of crops and exacerbating existing ecological concerns such as flooding, soil degradation, and groundwater depletion.

The contrast between industrialized and developing nations underscores disparities in agricultural resources and opportunities. While over 50% of people in developing countries are engaged in agriculture, they often lack access to advanced methods and technologies, trailing behind their counterparts in wealthier nations where agricultural conditions are markedly superior.

Yet, amidst these disparities lies the promise of progress. Advanced technologies, particularly big data and AI, hold the key to unlocking new frontiers in agriculture. Integrated systems harnessing these innovations are poised to revolutionize the industry, facilitating tasks such as yield forecasting and sowing with unparalleled precision. The advent of modern machinery, including agricultural robots and cloud computing, signals the dawn of a new era of super-convergence in farming, where cutting-edge technologies converge to propel agricultural productivity while safeguarding ecological integrity.

Conclusions

The exploration of intelligent and sustainable agriculture unfolds a compelling narrative of innovation, responsibility, and the promise of a more resilient and harmonious future for our planet. The rise of sustainable and intelligent farming marks a profound shift transcending conventional agricultural practices, representing a holistic transformation rather than merely a technological upgrade. The integration of digital technologies into smart agriculture heralds a new epoch of resource management, efficiency, and precision. By furnishing farmers with data-driven insights, these technologies empower informed decision-making, optimal resource allocation, and enhanced yields. In the pursuit of increased agricultural productivity, technology emerges as a formidable ally, epitomized by the deployment of autonomous machinery, drones, and sensors. Moreover, at the core of this transformative paradigm lies sustainability—a commitment to cultivating agricultural practices that preserve ecological balance and ensure long-term viability. Indeed, agriculture stands poised for a luminous and sustainable future.

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Synergizing Soil and Water Conservation, Artificial Intelligence and Agro-Biodiversity for Sustainable Agriculture in Northeast India

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Abstract

Northeast India, with its unique environmental conditions and rich cultural heritage, is at a crossroads in its agricultural development. To ensure sustainable growth, it is essential to integrate traditional soil and water conservation practices with modern technological advancements such as Artificial Intelligence (AI), while also preserving agro-biodiversity. This article explores the intersection of these elements and proposes a holistic framework for advancing agricultural sustainability in Northeast India.

1. Introduction

Northeast India, encompassing states like Assam, Meghalaya and Nagaland, is characterized by its diverse ecosystems and rich cultural traditions. The region's agriculture, heavily influenced by its geographical features and climatic conditions, faces numerous challenges. These include soil erosion, water scarcity and the impacts of climate change. Addressing these issues requires a comprehensive approach that combines traditional wisdom with modern technology. This article delves into soil and water conservation measures, the role of AI in agriculture, and the significance of agro-biodiversity and ethnobotany, aiming to present a holistic strategy for sustainable agricultural development.

2. Soil and Water Conservation Measures

2.1. Traditional Soil Conservation Practices

Soil erosion is a critical concern in Northeast India due to the region's hilly terrain and heavy rainfall. Traditional practices such as contour plowing, terracing and the use of organic mulch have been employed for centuries to mitigate soil erosion and enhance soil fertility. Contour Plowing involves plowing along the contours of the land, which helps in reducing runoff and soil loss. In the Khasi and Jaintia Hills of Meghalaya, contour plowing is combined with the planting of cover crops to stabilize the soil. Terracing creates step-like fields on slopes, reducing the velocity of water runoff and allowing it to be absorbed into the soil. Terraces are commonly used in the agricultural practices of the Nagas and the Mizo tribes. In organic mulch Farmers use organic materials such as straw, leaves and compost to cover the soil surface. This not only helps in retaining moisture but also improves soil fertility by adding organic matter. These traditional practices are complemented by modern soil conservation techniques such as check dams, sediment traps and erosion control blankets. Check dams built across streams and gullies help in slowing down water flow and capturing sediment. Sediment traps are used to collect soil particles carried by water, reducing soil loss downstream.

2.2. Innovative Water Conservation Strategies

Water management is crucial for agriculture in Northeast India, where rainfall can be erratic and uneven. Traditional methods such as bamboo drip irrigation and water harvesting systems have been used to optimize water use. In Meghalaya, farmers use bamboo pipes to channel water from streams directly to their fields (Bamboo Drip Irrigation). This low-cost, efficient irrigation method minimizes water wastage and is well-suited to the region's terrain. Traditional rainwater harvesting techniques involve collecting and storing rainwater in reservoirs or tanks for later use. Modern rainwater harvesting systems incorporate filtration and storage technologies to improve efficiency. Integrated watershed management involves planning and managing the entire watershed area to ensure optimal water use. This includes activities such as reforestation,

soil conservation and the construction of small check dams. These modern strategies are designed to address the increasing water demands and variability caused by climate change. By combining traditional methods with new technologies, farmers can better manage water resources and improve crop yields.

3. Artificial Intelligence in Agriculture

3.1. Precision Agriculture and Data-Driven Insights

Artificial Intelligence (AI) is transforming agriculture by providing precise, data-driven insights that enhance productivity and efficiency. Precision agriculture uses AI technologies such as remote sensing, drones and satellite imagery to collect and analyze data. In remote sensing satellites and drones equipped with sensors capture detailed images of crops and soil. This data is analyzed to monitor crop health, detect nutrient deficiencies and identify pest infestations. For example, multispectral imagery can reveal variations in crop growth, allowing farmers to apply targeted interventions. Drones are used for aerial surveys and real-time monitoring. They can cover large areas quickly, providing high-resolution images and data that help in making informed decisions about irrigation, fertilization and pest control. Satellites provide valuable information on weather patterns, soil moisture and land use. This data helps in predicting crop yields, managing resources and planning agricultural activities.

3.2. Predictive Analytics and Decision Support

AI-driven predictive analytics uses historical and real-time data to forecast future events and trends. This capability is crucial for managing risks and making strategic decisions. AI algorithms analyze historical weather data and current conditions to provide accurate weather forecasts. This information helps farmers plan their activities, such as planting and harvesting, to avoid adverse weather conditions. Predictive models use data on weather conditions, crop types and historical pest outbreaks to forecast pest and disease risks. Early warnings allow farmers to take preventative measures, reducing crop losses and minimizing the need for chemical treatments.

3.3. Automation and Efficiency

AI-driven automation is revolutionizing agricultural operations by improving efficiency and reducing labor requirements. Robotic systems for planting, weeding and harvesting automate labor-intensive tasks. For example, robotic planters ensure precise seed placement, while automated harvesters reduce the time and labor needed for crop collection. AI-based smart irrigation systems use real-time data on soil moisture and weather conditions to optimize water use. These systems automatically adjust irrigation schedules, reducing water waste and improving crop health. AI algorithms analyze data on crop yields, market demand, and logistics to optimize supply chains. This helps in reducing food waste, improving market access and maximizing profitability.

4. Agro-Biodiversity and Ethnobotany

4.1. The Value of Agro-Biodiversity

Agro-biodiversity refers to the variety of plants, animals and microorganisms used in agriculture. In Northeast India, agro-biodiversity is crucial for maintaining ecological balance and ensuring food security. Traditional agricultural systems in Northeast India incorporate a wide range of crops, including staple grains, pulses, vegetables and fruits. This diversity reduces the risk of crop failures and enhances food security. The region also supports a variety of livestock, including cattle, goats and poultry. This diversity contributes to sustainable farming practices and provides a source of income and nutrition for local communities. The preservation of native plant species is essential for maintaining ecological balance. Many indigenous plants have adapted to local conditions and play a role in soil conservation, pest control and nutrient cycling.

4.2. Ethnobotanical Knowledge and Its Application

Ethnobotany is the study of the relationship between people and plants. In Northeast India, traditional knowledge of plant uses for food, medicine and cultural practices is invaluable. Indigenous communities use a

variety of plants for treating ailments and promoting health. Documenting and preserving this knowledge can lead to the discovery of new medicines and enhance healthcare options. Many plants are integral to cultural practices and rituals. Preserving this knowledge helps maintain cultural heritage and fosters a connection between communities and their environment.

4.3. Conservation and Utilization of Traditional Knowledge

Efforts to conserve and utilize traditional agricultural knowledge involve community-based initiatives and research. Establishing seed banks helps in preserving traditional crop varieties and ensuring their availability for future generations. These seed banks also support research on crop improvement and adaptation. Protecting sacred groves and traditional landscapes helps in conserving plant species and ecosystems. These areas serve as refuges for biodiversity and are often managed through community-based conservation efforts. Documenting traditional practices and ethnobotanical knowledge is crucial for preserving cultural heritage and ensuring the continued use of indigenous plants and techniques.

5. Integrative Approach

5.1. A Holistic Strategy for Sustainability

Integrating soil and water conservation techniques with AI technologies and the conservation of agro-biodiversity provides a comprehensive framework for agricultural sustainability. This approach addresses multiple challenges simultaneously and promotes a balanced, resilient agricultural system. By combining traditional soil and water conservation practices with modern technologies, farmers can optimize resource use, improve productivity and enhance resilience to environmental changes. The use of AI in precision agriculture complements traditional practices by providing data-driven insights and automation. This integration allows for more efficient and targeted interventions. Preserving agro-biodiversity and traditional knowledge ensures the continued availability of diverse crops and practices. This conservation effort supports ecological balance and enhances food security.

5.2. Policy Support and Community Engagement

Successful implementation of these strategies requires supportive policies and active community engagement. Governments and policymakers should support sustainable agricultural practices through incentives, subsidies and regulations. Policies that promote research, technology adoption and conservation efforts are essential for long-term success. Engaging local communities in decision-making and implementation ensures that practices are culturally appropriate and effective. Community-based initiatives and partnerships between farmers, researchers and organizations are crucial for promoting sustainable agriculture. Providing education and training on modern technologies, conservation practices and traditional knowledge helps empower farmers and enhance their capacity to adapt and innovate.

6. Conclusion

The future of agriculture in Northeast India depends on a balanced approach that integrates traditional wisdom with modern technology. The integration of soil and water conservation measures, the deployment of Artificial Intelligence in agriculture and the preservation of agro-biodiversity collectively form a triad essential for sustainable development. Traditional soil and water conservation techniques have long served as the bedrock of sustainable farming practices in the region, preserving soil fertility and ensuring water availability. These time-tested methods must be preserved and enhanced through modern techniques such as precision agriculture and smart irrigation systems powered by AI. The synergy between tradition and innovation can significantly mitigate the risks posed by climate change, soil degradation and water scarcity. Artificial Intelligence is poised to revolutionize agriculture by offering unprecedented levels of precision and efficiency. From optimizing planting schedules to predicting pest outbreaks and automating labor-intensive tasks, AI empowers farmers with the tools needed to maximize yields and reduce environmental impact. However, the successful adoption of AI requires not only access to technology but also education and training to ensure that farmers can leverage these tools effectively. Agro-biodiversity, enriched by the region's

ethnobotanical knowledge, is invaluable for maintaining the resilience of agricultural systems. The preservation of diverse crop varieties, livestock and traditional medicinal plants is essential for food security and ecological stability. By documenting and conserving this biodiversity, Northeast India can safeguard its agricultural heritage and contribute to global efforts in biodiversity conservation.

The vision for sustainable agriculture in Northeast India is one where traditional wisdom and modern science coexist and complement each other. This holistic approach not only addresses the immediate challenges of soil erosion, water management, and crop diversity but also prepares the region for future challenges such as climate change and global market pressures. By embracing this integrative strategy, Northeast India can not only sustain its agricultural productivity but also enhance its role as a model for sustainable agriculture in other parts of the world. The journey towards sustainable agriculture in Northeast India is a dynamic process that requires continuous adaptation and innovation. By synergizing soil and water conservation, artificial intelligence and agro-biodiversity, the region can ensure a prosperous and sustainable future for its farming communities, preserve its rich cultural heritage and contribute to the global goal of achieving food security and environmental sustainability.

ABSTRACTS

Theme 1: Traditional wisdom of organic and natural farming

T1A-1

Possible Uses of Jivamurt with Natural Minerals to Boost Crop Productivity under Natural Farming in the North East Region of India

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Abstract

The North Eastern region of India is bestowed with culture and biodiversity, the region has humid sub-tropical climatic condition. The region receives more than 2000 mm on an average rainfall each year. The rice based cropping system is prominent system in this region. The biotic constraints like high rainfall and mid-season drought also adversely affects the performance of the crops. The abiotic stress like acidic soils, poor in macronutrient cations, poor soil fertility due shifting cultivation is major reason caused the low productivity of the agricultural crops. The farmers are employing suboptimal farm input. The consumption of synthetic chemical fertilizers is only 12 kg/ha. Hence, the region has enormous potential in natural and organic farming. The region has high organic carbon status particularly in hilly part, thus proper agronomic practices can raise the productivity of the crops grown under natural farming. Further, the productivity of the crops of the region can be improved by the efficient management of agronomic practices. The use of raw minerals along with the native microbial formulations like jivamurth can meet out of the nutrient demand of the crops. The microbial studies revealed that jivamurt had higher beneficial microorganism including N-fixers, P-solubilizers, K-solubilizers fungi and actinomycetes. The rock phosphate, mica and polyhelite minerals are source of phosphorus, potassium and other secondary nutrients, however, release of nutrients from these minerals are slow, hence, the process of mineralization of the minerals may be improved by treatment of the jivamurt.

Keywords: *Jivamurt, Natural Farming, biodiversity*

T1A-2

Production and processing of organic ginger for livelihood improvement in North Eastern Hill region

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Abstract

The North Eastern Region of India comprises of the states of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland Sikkim and Tripura. NEH region occupies about 5 % area and 3% production of total spices in India. This region is recognized as one of the 'hotspots' or 'mega diversity' centres of natural diversity. Ginger (*Zingiber officinale* Roscoe.) is the main cash crop supporting the livelihood and improving the economic condition of many ginger growers of this region and the leading ginger producing states are Meghalaya, Mizoram, Arunachal Pradesh and Sikkim. The ginger produced in higher altitude contains high oleoresin and gives higher oil recovery. In Tripura Ginger is cultivated in jhum land, uplands and sometimes in slopy tilla land also. Ginger is grown in an area of 5.0 thousand hectares with production of 6.41 thousand tonnes. Apart from improved varieties like Nadia, China, Varada, etc., a number of local cultivars exist in this region. These varieties are high yielder of rhizomes as compared to standard cultivars like Nadia and Rio-De-Janeiro but have more fibre content. The popular variety cultivated in this region is Nadia, which contain low fibre (4.10%) and have high demand for commercial use. Black ginger having rhizomes with bluish black tinge inside is reported to have medicinal properties and is grown by the tribes of Tripura for their household use only. It is also said to be sold at very high price probably due to its high medicinal value. Ginger productivity in the NEH region is 6.79t/ha which is much higher than the national average (3.57t/ha). Though traditional varieties are low in production, but it is still favoured by the farmers of these regions because they are better adapted to the changing environment and the farming practices of the particular area. After harvest the seed rhizomes are stored in the pit and covered with sand. By March-April when the rhizomes start sprouting, they are taken out and planted in the fields. In the plains of Tripura ginger is grown in raised bed (bun) and furrow planting system. Raised beds (25-30 cm) of about 1 m width are preferred as compared to flatbed planting. Ginger is planted in shallow pits in lines (30-45 cm spacing between lines) leaving 15-20 cm spacing between plants in a row. Integrated nutrient management practises along with the application of lime, neem cake provides the best quality rhizome. Ginger is grown either as sole crop or as intercrop in maize, French bean, tapioca, Mango, chillies etc. When it is intercropped the inter-row distance is generally wider (60 to 90 cm). Although ginger yield in monoculture was reported higher, net return was higher when intercropped in maize or with French bean. In addition mulching with *Accacia*, *Tephrosiasp* and *Gliridicidia* (2-2.5 t/ha on dry weight basis) improved yield and quality. Farmers sell their produce at a very low price to local market or middle man. Processing and value addition of ginger can fetch a good price to farmers and thus help in improving their livelihood. Ginger can be used in the form of ginger tea, dried powder, preserved slices, cookies, candy, tinctures, sodas, jam, beer, capsules and Syrup. Soft drinks like cordials, ginger cocktail, carbonated drinks, etc are some of the value added products of ginger. Commercial processing of ginger using mechanized peeler, boiler, drier, packaging and marketing brings higher returns to the growers. Thus production and value addition of ginger can play a significant role in improving the livelihood and economic security of the farmers of NEH region.

Key words: *Ginger, oleoresin, production, value addition, income*

T1A-3

Pest management of Soybean in organic agriculture through different botanical amendments

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Abstract

Soybean (*Glycine max* L.) is a major source of protein and lifted the socio-economic status of soybean farmers. Manipur has great potential for the production and domestic utilization of soybean and its derivatives for the health and economic benefits of the people of the state. Severe incidence of lepidopteran defoliators is encountered in soybean cultivated tracts of this region. Intensive agriculture including the use of pesticides has led to enormous levels of chemical buildup in soil, in water, in air, in animals and even in our bodies causing an imbalance in our environment adversely affecting the health of nature. As the entire NEH region still practices traditional agriculture, the concept of organic farming is not new, hence the farmers show an inclination towards organic agriculture. Various eco-friendly insecticides from natural resources viz., neem-cow urine extract, mixed leaves extract, cow urine-mixed leaves fermented extract, chilli-garlic extract, marigold extract and neem seed kernel extract (NSKE) can be used and found effective against the major lepidopteran pest of soybean viz., Tobacco caterpillar, bean leaf webber, Bihar hairy caterpillar and soybean aphids. A case story of farmer of Andro, Imphal East showed a reduction in the infestation of soybean pests in his farm increasing production and his annual net income was increased by 43%. The transition to organic agriculture and the adoption of plant origin amendments helps to conserve the flora, utilize its properties in an eco-friendly manner and create marketing opportunities for organic products.

Keywords: *Soybean, Lepidopteran defoliators, NEH region, Organic agriculture, Eco-friendly*

T1A-4

Development of Solar-Powered Paddy Thresher to Promote Sustainable Agriculture in Northeast India

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Abstract

Agriculture is vital for the inhabitants of Northeast India, as many locals depend on farming for their livelihoods. However, troubles like post-harvest losses, inefficient energy usage, and laborious manual threshing plague conventional farm systems in the area. To address these problems, the primary aim of this undertaking was to develop and assess a solar-powered rice thresher suited for smallholders. The objectives involved constructing a solar-powered rice thresher customized for marginal farmers, analyzing its effectiveness through field testing, and gauging user perspectives during operation. Farmers with restricted access to power sources can meet energy needs through solar energy, an eco-friendly solution. The thresher is designed to run by an AC motor powered solely by solar energy. According to the specifications, it weighs 64 kg and measures 920 ×350 × 850 mm in dimensions. Operating at 450 rotations per minute, it can thresh between 175 and 200 kilograms of material per hour. Reliable functionality stems from the machine's motor, inverter, battery, and solar panels. Comparing the solar thresher to manual threshers through fieldwork revealed significantly boosted productivity and threshing capacity. Participants' physical attributes and discomfort levels were also evaluated, finding that the solar thresher enhances ergonomics and demands less exertion. The research findings conclude that solar-powered paddy threshers offer small-scale farmers in Northeast India an economical, effective, and environmentally friendly option. This machine can bolster the region's agricultural development and economic growth by boosting agricultural production, reducing post-harvest losses, and promoting sustainable farming practices.

Keywords: *Agriculture, Solar-powered paddy thresher, Post-harvest losses, Sustainable farming, Energy efficiency*

T1A-5

Remunerative Integrated Farming by Using ITK's

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Abstract

Globally, the cultivation of organic crops under the organic farming system is progressively gaining momentum. In India, it is an alternative to chemical based agriculture which will help to achieve security in food, livelihood in sustained manner benefiting the ecology as well. The Economic Survey 2022–23 estimates that there are 4.43 million organic farmers in India at the present time. Over the next three years, 10 million farmers are to beassisted in switching to natural farming by the Union Budget 2023–2024. There is a lot ofopportunity in India's North Eastern Region (NER) to promote organic farming, North East India is the hub of organic production .The Integrated Organic Farming and System (IOFS) – including environmentally conscious businesses such as crops (Agriculture/ horticulture), live stocks ,fisheries, and

duckeries, fodder and provision for soil and water conservation along with production of high-quality and manures and remunerative bio-fertilizers like azolla,FYM for increasing the overall productivity and farmer income. North Eastern region with its diverse tribe also comes the richness of traditional knowledge, the tribal's acumen with using natural methods to combat natural problems are priceless, some noteworthy examples being, the Adi tribes of Basar insert 5 bamboo sticks randomly at the flowering stage in rice field with dead frogs or crabs to attack adult Gundhi bugs, Nishi tribes of Arunachal Pradesh keep 'Gurung' i.e rat traps. Garo tribes of Meghalay use thatched grass, bamboo structures with wooden poles for grain storage, rice-fish system of Apatani plateau, ZABO system of Nagaland are a few to start with, more of such ITK's followed by different states starting from sowing and germination of seeds, land preparation, plant protection, storage etc are source of immense input for continued and sustained organic cultivation.

T1A-6

Traditional wisdom of organic and natural farming

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Abstract

Traditional wisdom is unique local knowledge existing within and developed around specific condition of men and women indigeneous to particular geographic area .It is a comulative body of knowledge and belief handed down to generations by cultural transmission about the relationship of living beings with one another and with their environment. It depend on traditional knowledge to preserve ecosystem, biodiversity and maintaining the sustainable food and human health . Farmers possess a vast pool of Indigeneous knowledge which reduces external inputs by utilising various renewable farm resources. These are valuable practices that provide farmer to farmer training or local technology transfer. It is extensively used in the fields for ensuring better productivity and more profit to local farmers. Natural farming is a sustainable farming which makes all inputs from natural materials, observes the law of Nature and respects the rights of crop and livestock. It is based on Nature's wisdom. For example Farmers check the right time for sowing of seeds by estimating the amount of soil moisture in the soil simply by making a ball of soil in the field. Cellar is an underground structure constructed by digging pits with length and breadth and depth ranging from 3 to 5m depending on the requirement of farmers to store vegetable in winter months. When Natural farming is practiced, the soil and water become clean and ecology is recovered .It is even being used as a tool to fight desertification. Organic farming which is a systematic agricultural system designed to enhance productivity and ecological sustainability. It prioritizes use of organic materials like compost, cover crops etc. It emphasizes on soil health, biodiversity conservation and the use of environmentally friendly agriculture techniques. Organic and natural farming aim to cultivate in harmony with nature prioritizing ecological balance and less reliance on chemical alternatives. The traditional wisdom in agriculture sector is fast vanishing. Younger generation is not aware of all these practices .It is necessary to sensitize them about the economic and environment benefits of indigeneous agricultural practices.

Keyword: *Traditional, Organic farming, Natural farming, Biodiversity, Cellar*

T1A-7

Traditional Wisdom of Organic and Natural Farming

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Abstract

For millennia, farmers have relied on practices that promote healthy soil, manage pests naturally, and produce bountiful harvests. This traditional wisdom forms the foundation of modern organic and natural farming techniques. Key elements of this wisdom include: Working with nature: Observing natural cycles, fostering biodiversity, and promoting a balanced ecosystem are central to traditional farming. This creates a resilient system less reliant on external inputs. Soil health is paramount: Traditional practices emphasize building healthy soil through composting, cover cropping, and crop rotation. This fosters a thriving microbial community that provides nutrients for plants and enhances disease resistance. Local knowledge, global benefits: Traditional farmers have a deep understanding of their local environment and have developed practices suited to those conditions. This knowledge is being integrated with modern science to create sustainable agricultural systems around the world. By understanding and applying these time-tested practices, organic and natural farmers can produce healthy food while promoting environmental well-being. Here are some common Indigenous Technical Knowledge (ITK) practices used in organic and natural farming across India: Soil Management: Vermicomposting: Using earthworms to break down organic matter into nutrient-rich vermicompost . Jeevamrut: A fermented concoction of cow dung, urine, jaggery, and water used as a natural fertilizer and soil conditioner. Seed Treatment: Panchgavya Seed Treatment: Seeds are dipped in a mixture of five cow products (dung, urine, ghee, milk, and curd) to improve germination and disease resistance. Pest Management: Neem-based pesticides: Using neem leaves or oil as a natural insect repellent and pesticide. Companion planting: Interplanting different crops to deter pests and attract beneficial insects. Indigenous repellents: Using locally available plants like chilies or garlic to deter pests.

T1A-8

Traditional Wisdom of Organic and Natural Farming

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Abstract

Organic and natural farming is an ancient methods promote not only healthy crops at present, but also maintain environmental balance and sustainable farming for future generation. Organic farming is native to India. Role of organic and natural farming in modern agriculture: Recognizing the multifaceted challenges face by the modern agricultural sector, including environmental degradation, climate change, soil degradation and socio-economic disparities, the paper explains the benefits of traditional or organic farming to cope up with these problems. Benefits of organic and natural farming: Soil health- only using organic matter promote soil retention capacity and by not using chemical fertilizer it reduce the soil pollution, Environmental friendly- organic agriculture reduces non-renewable energy use by decreasing agrochemical needs, Promote sustainable development- it reduces carbon emissions, improve soil health, reloads natural eco system while producing healthy crops and livestock without damaging the environment, Cyclic in nature- organic residues and nutrients produced in the farm are recycled back to the soil, Source of employment- it required lots of labour for farm operations as the works are done manually from ancient period, High nutritive value- it provide chemical free crops for good health with high antioxidant properties, Promote biodiversity- in natural farming the amount of human input are reduce to create suitable habitats for soil fauna (earthworms) and wild species. The paper concludes by truly supporting the concept of traditional wisdom of organic and natural farming to fed the growing population over the world with compromising the sustainability of agricultural farming system.

T1A-9

Traditional wisdom of organic and natural farming

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Abstract

Traditional wisdom in farming, encompassing practices passed down through generations, emphasizes sustainability, soil health, and biodiversity. Organic farming prioritizes natural inputs and holistic ecosystem well-being, guided by principles of health, ecology, fairness, and care. Core objectives include preserving soil health, promoting biodiversity, and protecting human health. Key methods involve eliminating synthetic inputs, natural pest control, and enhancing soil health. In India, methods like crop rotation, composting, and pest management are prevalent. Natural farming, epitomized by the Fukuoka Method, mimics nature without external inputs, fostering soil health and biodiversity at low cost. Both approaches offer benefits such as environmental conservation, resilience, and efficient resource use. Integrating traditional wisdom into modern agriculture can enhance sustainability and food security. In conclusion, organic and natural farming represent chemical-free, holistic approaches rooted in stewardship and respect for the Earth, offering hope amid contemporary challenges.

T1A-10

Traditional Wisdom of organic and natural farming

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Abstract

Organic and natural farming are based on traditional wisdom, which provides a rich tapestry of information that has supported farming communities for many years. This abstract examines the underlying ideas, approaches, and continuing applicability of conventional wisdom in organic and natural farming. A philosophy firmly ingrained in the knowledge of our forefathers, organic farming emphasizes the inextricable link between biodiversity, soil health, and human well-being. Compost, manure, and cover crops are examples of organic inputs that organic farmers prioritize using to enhance soil fertility with the least amount of environmental damage possible. The comprehensive approach of organic farming is embodied in crop rotation, companion planting, and biological pest management techniques, which promote resilience and sustainability in agricultural ecosystems. In a similar vein, natural farming advocates minimal interference and harmonization with natural processes, drawing inspiration from traditional methods and indigenous knowledge. Natural farming, led by visionaries like Masanobu Fukuoka, encourages simplicity, observation, and harmony with the natural world. Natural farmers use methods like polyculture, seed balls, and no-till farming to create self-sufficient agroecosystems that can prosper without the need for artificial inputs. Indigenous wisdom, community resilience, and cultural heritage are all part of the traditional wisdom ingrained in organic and natural farming, which goes beyond agronomic practices. Indigenous agricultural methods provide unique insights on climate resilience, sustainable land management, and seed saving because they are based on decades of observation and adaptation. In an era of climate change, environmental degradation, and food insecurity, it is critical to embrace the conventional wisdom surrounding

organic and natural farming practices. We can develop regenerative food systems that support social justice, food sovereignty, and ecological resilience by respecting indigenous knowledge and custom.

T1A-11

Traditional wisdom of Organic and Natural Farming

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Abstract

The word 'indigenous ' is used to or refer to the people who originally lived in a place ,rather than people who moved there from somewhere else .Indigenous Knowledge (IK) thus can be defined as a corpus of knowledge of peoples belonging to a particular geographical area. Native knowledge, traditional knowledge, cultural knowledge and civilization knowledge are synonymous terms. It is unique to a given culture, society or a country .Indigenous Knowledge is a unique, traditional and local knowledge existing within and developed around specific conditions of women and men indigenous to particular geographical area. Insects' pests cause serious damages to crop &livestock. So in organic method Garlic solution, Neem oil, pepper, soap solution is used. E.g.; Ancient farmers in Sri Lanka successfully protected the crops using traditional plant bases materials &cultural traditions. We can also use plant –based products, crop residues like husk, shell, ash, animal products like cow urine, cow dung, milk, minerals like red earth, sand etc. Natural farming being promoted today by the government is also in fact a synthesis of indigenous knowledge .All the four components of Natural farming like Beejamrit, jeevamrit, Mulchinf & Wapasha are the outcome of Indigenous wisdom accumulated through experience & practice. The various plant protection preparations like Neemastra, Brahmastra , Agniastra & Dashparni extract used in natural farming are the outcome of local wisdom. Farmers can check the right time for sowing seed by estimating the amount of soil moisture in the soil simply by making a ball of soil of their fields. The ultimate goal of farming is not the growing of crops, But the cultivation and Perfection of human beings.

T1A-12

Improvement of Soil Properties under Natural Farming

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Abstract

In the past years, Green Revolution paved the way of immediate food security concern through yield enhancement by advocating intensive cultivation practices and immense application of chemical fertilizers. Subsequently, this resulted into collapse of the soil quality. Natural farming also called "do-nothing farming" is the method by which the traditional age-old practices are followed in a sustainable and scientific manner which helps in regaining the soil vitality. This chemical free approach of farming is a relevant solution to the limitations faced by the existing farming system that advocates intensive cultivation practices with high value inputs. Realizing the gradual soil health decline, the farmers of India has now moved towards this pro-ecological option of natural farming. Various concoctions or formulations are prepared and applied in-situ which activates the soil micro-biota emphasizing better soil health. Earthworm activity and microbial population are multiplied by NF formulations like Jeevamrit, Beejamrit which improves soil nutrient availability, build up the resistance mechanism, and boosts crop productivity. It is claimed that all the nutrients a crop needs are already present in the soil, and application of benefcial microorganisms present in Jiwamrita catalyses the transformation of nutrients locked up in the soil into plant-available forms (Biswas 2020; Keerthi *et al*. 2018; Korav *et al*. 2020). Other such formulations include Ghanjeevamrit, Saptadhanya extract, etc. Other components include Acchadan (mulching), Whapasa, Multi-storeyed cropping, inclusion of leguminous crops etc. which result in effective utilization of locally available on-farm resources. Application of these formulations has been found to effectively increase the organic carbon content, NPK content in the soil. As North-East being the hub of immense possibilities in sustainable natural farming because of the less disturbed soil of the region, implementation and augmentation of Natural Farming is expected to go a long way in rejuvenating the sustainable ecosystem of the region.

Keywords: *Natural farming, Soil, Formulations, Sustainability*

T1A-13

Quality of bread wheat as influenced by integrated effect of natural farming concoctions and organic farming practices with various NPK doses

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Abstract

The field experiment was carried out during the *Rabi* 2021-22 and 2022-23 at experimental block, School of Agricultural Sciences, Shri Guru Ram Rai University (SAS-SGRRU), Pathribagh, Dehradun, Uttarakhand to study the effect of various nutrient management approaches on NPK content, NPK uptake and protein content in wheat. The experiment was laid out in split plot design with three organic nutrient management treatments in main plots *i.e.*, organic farming practices (vermicompost @ 5 t ha^{-1} + seed inoculation with *Azotobacter* and PSB + 2 sprays of vermiwash at 30 & 45 DAS); Natural farming practices (sieved cow dung @ 2.5 t ha^{-1} + seed treatment with *Bijamrit* + *Jeevamrit* @ 200 l ha^{-1}); and absolute control. The sub-plots comprised 100% recommended dose of fertilizers (RDF), 75% RDF, 50% RDF and 25% RDF. The experiment had three replications. The results revealed that the integration of organic farming practices, natural farming practices and different doses of NPK fertilizers influenced all the quality parameters in wheat grain during both the years. Organic farming practices exhibited 15% and 12% increment in protein content during 2021-22 and 2022-23, respectively, compared to the absolute control; and 12% and 8% increase over natural farming practices. However, 75% RDF secured 10% and 7% more protein over 100 % RDF, 13% and 11% over 50% RDF and 19% and 10% over 25% RDF during both the consecutive years, respectively. Furthermore, NPK content and uptake by grains and straw were found to be higher in organic farming practices and 75% RDF as compared to other treatments. Thus, adoption of organic farming practices coupled with application of 75% NPK is recommended for enhancing protein, nitrogen, phosphorus and potash content, thereby sustaining nutritional quality of wheat in the western Himalayan zones of Uttarakhand.

Key words: *Natural farming, NPK content, NPK uptake, organic farming, Protein, Wheat*

T1A-14

Wisdom of organic and natural farming

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Abstract

Natural and organic farming are examples of chemical-free farming techniques that focus on ecosystem management and aim to reduce or eliminate external agricultural inputs, particularly synthetic ones. It has been determined that maximizing agri-production through the intense use of pesticides, artificial fertilizers, and other inputs is necessary to meet the rising population's food needs. On the other hand, the careless use of chemical inputs has seriously endangered life. Achieving a balance between the production of food that is safe, healthful, high-quality, and environmentally sustainable and the need to produce enough food to meet the predicted food demand is a difficult issue. In an effort to produce high-quality food without harming the environment, chemical-free farming techniques such as natural and organic farming aim to reduce or completely eliminate external agricultural inputs. However, the term "natural farming" has come to refer to a concept of chemical-free, diversified agriculture-based farming practices that place more emphasis on affordable native resources and management techniques. Natural farming minimizes or avoids the use of inputs that are purchased externally and emphasizes the use of native resources with agro-ecological principles, community participation, and common resource management for the benefit of farmers and the larger farming community. India has been working hard over the past ten years to change the mindset of various stakeholders so they will embrace natural agricultural methods that are supported by research. With the available of good and quality organic input supply, India can safely switch 2% of its cultivated land annually from conventional farming to organic or natural farming (ONF) without compromising food supply, and by 2030, it may replace about 20% of its conventional land with ONF this may lead to successful production of 400 tonnes of food grains to feed the rising population by 2050 through natural and organic practices.

T1A-15

Organic Farming for Sustainable Fruit Production in India

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Abstract

At the time of the green revolution, the intensive use of chemicals in agriculture may have contributed to a dramatic increase in crop yield, ensuring food security in India; however, the intensive use of chemical fertilizers and pesticides resulted in a gradual decline in soil health and ecological balance, and food safety became a major concern. This has

generated concerns about the long-term viability of agriculture/horticulture, advocating attention to sustainable production approaches. Accepting the detrimental effects of excessive chemical fertilizer use on soils health and pesticides on human health, an integrated management approach is required. Organic farming may produce high-quality food without negatively impacting soil health or the environment, making it one of the sustainable solutions. Organic food is not only appealing, but it is also linked with high-quality, healthful, and natural items, as opposed to further processed and conventional foods. The paper has been assessed for organic fruit cultivation in India using a sustainable strategy. Manures, green manures, intercropping, mulching, vermiculture biotechnology, biofertilizers, homa farming/agnihotra, biodynamic farming, biocontrol, and other components are important components of organic farming. Bio-fertilizer proved more successful than organic manures in improving fruit development metrics. When bio-fertilizers were combined in "Red Fleshed" guava, P-solubilizers were found to have a more favourable influence on fruit physicochemical features than N-fixers.

Keywords: *Green revolution, intensive, ecological balance, organic farming, sustainable agriculture*

T1A-16

Organic Farming: Current Scenario in North-Eastern region of India

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Abstract

Agriculture is the backbone of Indian economy. The rapid advancement of technology has led to the unbalanced disruption of our ecosystem through the indiscriminate use of vast quantities of chemical fertilizers and pesticides. So organic farming is the only solution to nurture the land and regenerate the soil. The North Eastern Region (NER) of India has tremendous potential for promotion of organic farming. Despite inherent nutrient deficits and supplementing these to harness higher land, water and crop productivity, low use of synthetic fertilizers (< 12.0 kg/ha) and chemicals are common in the north eastern hill ecosystems. In the Northeast region, a total of 198,348 hectares are dedicated to organic farming, comprising 138,328 hectares certified under NPOP and an additional 60,020 hectares under conversion. Sikkim leads with 75,475 hectares, while the remaining seven states show promising strides towards embracing organic agriculture. Traditional use of bulky organic manure (FYM) has been substituted through integrated organic nutrient management (IONM) approach by combining application of mixed compost, vermicompost, manures, in addition of *in–situ* and *ex–situ* bio–mulches and alley–cropping. However, in the region pest management approaches using biological control agents *viz. Pseudomonas* spp, *Trichoderma* spp., *Metarhizium anisoplia* have been found effective. The adoption of Integrated Organic Farming Systems (IOFS), encompassing crops, livestock, fishery, and duckery, not only facilitates the generation of quality manures but also enhances overall system productivity and farmer income. These agronomic practices collectively position the NER as a potential hub for organic agro-products. Government initiatives, including the Northeast Organic Farming Association of India (NOFA) and the Mission Organic Value Chain Development for North Eastern Region (MOVCD-NER), actively promote organic farming and provide vital support to farmers in the region.

Key words: *Integrated Organic Farming system (IOFS), Integrated Organic Nutrient Management (IONM), North Eastern Region, Organic farming*

T1A-17

Potential of Natural Farming for Sustainable Agriculture Development under Changing Scenario of Climate in North Western Himalayan

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Abstract

Indian agriculture is mainly contributing approximately 14.9 per cent in GDP to support 58 per cent of country population for livelihood. About 74 per cent farmers in India are small and marginal farmers, practicing organic farming by default because farming in rainfed areas and unaffordable modern agriculture technologies that encompass using fertilizers and pesticides. The role of natural farming in Indian rural economy can be leveraged to mitigate the ever increasing problem of food security in India. Natural farming could be introduced as an effective approach for achieving sustainable agriculture in area like rainfed and hill regions of India such as Uttarahand, Himachal Pradesh, Mizoram, Meghalaya and other mountain states, which are largely practicing traditional farming methods and have not switched to chemical farming. Natural farming is the system of the agro ecology based diversified farming which allows the functional biodiversity and takes into account various crops, trees and livestock and reduce the production cost by substituting the chemical fertilizers and pesticides with various home-grown products such as Beejamritham, Neemastra etc. and by use of intercropping as well as mulching. An alternate farming practices for increasing the farmer's income is the zero-budget natural farming. Natural farming may not be for the yield increasing purpose but it will increase the farmers' income for sure by reducing the cost and leads to long term sustainability. Natural farming take into account various activities such as enhancing the soil conditions by managing soil biological activities and organic

matter and enhancing the biomass activities. Zero budget natural farming emphasizes mainly on cost reduction, improvement in the land quality and last but not the least on increasing the farmers' incomes. Natural farming also known as eco agriculture or eco friendly agriculture is a neoteric approach for improving the traditional as well as modern agricultural practice and ensures the environment safety and community health. Natural farming is the practice which needs the public awareness and its participation for preserving the environment to restrict the further damage. This practice includes the sustainable agriculture, organic farming, agro ecology, ecoagriculture and the perm culture. Various features of natural farming are yields similar to chemical agriculture can be achieved, increment in soil fertility, minimization of water requirement. In India, Natural farming is encouraged as BPKP (Bharatiya Prakritik Krishi Paddhati Programme) under centrally sponsored scheme-PKVY (Paramparagat Krishi Vikas Yojana). In case of natural farming, there is no addition of chemical as well as organic fertilizers into the soil. Rather than this, encouragement of organic matter decomposition by microbes and earthworms is done on the soil surface itself, which further adds nutrition into the soil. In case of natural farming, ploughing, soil tilting and weeding is not processed and it would remain in a way, same as in natural ecosystems. Healthy soil micro biome is necessity for retaining, enhancing the soil organic matter. Concoctions are required to enhance the soil fertility. There are several different ways of concoctions formation. In India, the popular concoctions rely on fermentation of animal dung and urine and on an uncontaminated soil like Beejamruth, Jeevamruth, Ghanjeevamrit etc. These are major component of Natural farming.

T1A-18

Organic farming of turmeric & ginger for livelihood of Tribals in Jaintia hills Meghalaya

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Abstract

Organic farming is not only trendy in the modern world but it has many values in the domain of health and medicinal benefits too. The other dimension of organic farming is encouraging a new type of entrepreneurship a great source of livelihood as well as women's empowerment through (SHG) Self help group. The proposed project will take an initiative in understanding the best and successful stories related to organic farming of ginger and turmeric in Jaintia hills areas by the jaintia tribes. There will be an attempt in understanding the problems related to entrepreneurship development in the rural areas of Jaintia hills of Meghalaya. It will further attempt to unravel the difficulties of the smooth function of the Self Help Group. It will also look into the issue of women empowerment as well as a source of livelihood through organic farming. The project will critically examine both successful stories and unsuccessful stories in the Jaintia hills of Meghalaya among the Jaintia tribes. If the venture were unsuccessful possible explanations will be seeking for its failure. If the attempts have been successful how the best practices could be further improve. So the main objective of the proposed project is trying to understand successful and unsuccessful ventures and exploring initiative for replication of successful stories in Jaintia hills Meghalaya.

T1A-19

Enhancing rapeseed nutrition through organic inputs: Nourishing crops for healthier harvest and a greener future

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Abstract

An experiment on "Enhancing rapeseed nutrition through organic inputs" was carried out in the Instructional-cum-Research Farm, Assam Agricultural University, Jorhat to study the effect of different organic sources of nutrients on growth and yield of rapeseed (variety TS-67) during the rabi season of 2018-19. The treatments consisted of eleven levels of organic sources viz., T 1 (FYM @ 10 t/ha), T 2 (Vermicompost @ 5 t/ha), T 3 (Poultry Manure @ 5 t/ha), T 4 (FYM @ 5 t/ha + vermicompost @ 2.5 t/ha), T 5 (FYM @ 5 t/ha + poultry manure @ 2.5 t/ha), T 6 (Vermicompost @ 2.5 t/ha + poultry manure @ 2.5 t/ha), T 7 (FYM @ 5 t/ha + vermicompost @ 2.5 t/ha + mustard oil cake @ 1 t/ha), T 8 (FYM @ 5 t/ha + poultry manure @ 2.5 t/ha + mustard oil cake @ 1 t/ha), T 9 (Vermicompost @ 2.5 t/ha + poultry manure @ 2.5 t/ha + mustard oil cake @ 1 t/ha), T 10 (FYM @ 5 t/ha + vermicompost @ 1.25 t/ha + poultry manure @ 1.25 t/ha + mustard oil cake @ 1 t/ha) including T 0 (Control). The treatments were laid out in a randomized block design with three replications. Results revealed that the growth parameters, yield attributes and yield of rapeseed recorded at 30 DAS, 60 DAS and at harvest were significantly higher with the application of T 9 (Vermicompost @ 2.5 t/ha + poultry manure @ 2.5 t/ha + mustard oil cake @ 1 t/ha), followed by T 8 (FYM @ 5 t/ha + poultry manure @ 2.5 t/ha + mustard oil cake @ 1 t/ha) over other treatments and control. Application of organic nutrient sources also considerably increased the soil moisture contents recorded from two different depths viz., 0-20 cm and 20- 40 cm of the profile at flowering and siliquae development stages over the control.

T1A-20

Effect of Intercropping of legumes with Maize and Entomopathogenic Nematodes on Fall Armyworm (*Spodoptera frugiperda*) infestation

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Abstract

Fall armyworm, Spodoptera frugiperda (Noctuidae: Lepidoptera), is an economically important invasive pest infesting maize. Habitat manipulation as a method of conservation biological control which employs cover crops/hedge rows/flower strips crops in the main crop field to conserve the beneficial insect fauna like natural enemies. Entomopathogenic nematodes (EPNs) can be used to control this pest, and can be applied together with intercropping of maize with various leguminous crops. In this experiment, ten treatments of maize along with other leguminous crops and nematodes in intercropping were evaluated for the severity of damage caused by fall armyworm. Thus, the objective of this work was to evaluate the efficacy of EPN with intercropping to control S. frugiperda in corn crops. The results showed the maximum damage of the ear of maize was found in the untreated plot while the minimum damage was found in two treatments viz., maize + rice bean + EPN spray at 20DAS and maize + groundnut + EPN spray at 20DAS. The minimum percent leaf infestation and leaf score were also found in maize + groundnut + EPN spray at 20DAS viz., 36.67% and 1.29 respectively. The results of the study indicated the definite role of maize-legume intercropping with application of EPN in reducing fall armyworm damage in maize. This can be an eco-friendly alternative of the chemical insecticides to manage the pest and helps in the conservation of environment and natural resources.

Keywords: *Fall armyworm, Maize, EPN, Intercropping, Leguminous crops, Eco-friendly*

T1A-21

Organic Agriculture: A Reverting Approach for Sustainable Agriculture

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Abstract

Considering conventional agriculture, its effects and side effects on the health of soil and animals as well as human beings, it has become very important to look after the less harmful ways of growing crops. Organic farming is growing the crop by using natural inputs, natural farming is sustainable farming of crops with no external inputs. These are not new concepts these are the ways in which our ancestors used to grow crops traditionally. The techniques which we follow in organic farming are not developed newly but they are the age-old practices we are now just reverting to them in search of the same old quality. In this review we will discuss about the traditional techniques used in organic farming which include homa farming, reduced tillage, use of ash as a carbon source, use of organic mulches, live fencing, green manuring and cover cropping, composting, polyculture, crop rotation and natural control of crop enemies. In natural farming, we don't use any external inputs, completely reduced tillage, sowing of the seeds without disturbing the soil like doing it by dibbling, and growing the crops along with natural vegetation, without disturbing the natural flora and fauna. These are the methods of utilizing the natural resources in harmony with nature. After studying this review we will come to know that organic farming is not only about farming without chemicals but also about the environment, agricultural tradition, traditional seeds, animal welfare, farming communities, sensible energy use, water and soil conservation. There is an urgent need to reinvent the traditional methods of agricultural practices for sustained agriculture production.

Keywords: *Organic farming, sustainable agriculture, natural farming, traditional practices*

T1A-22

Precision Farming - A modern trend in Indian agriculture

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Abstract

Precision farming, a sustainable agriculture system of the twenty-first century, is a management approach that helps to increase crop productivity while lowering water and nutrient losses and adverse environmental effects by applying a suite of sophisticated information, communication and data-analysis techniques to the decision-making process. Additional terms used interchangeably for precision farming include information-based management, target farming, site-specific crop management, variable rate technology and grid farming. Precision farming has been utilised for pasture, animal management, viticulture and horticulture in addition to crop production. New technologies are being used to optimize agricultural operations and inputs in an effort to increase production while lowering input costs and yield losses. Examples of these technologies include artificial intelligence (AI), big data analysis, remote sensing, global positioning systems (GPS) and geographic information systems (GIS). The high spatial resolutions required for precision farming applications result in a considerable volume of spectral data generated by remote sensing systems using information and communication technologies. Vast amount of processed and stored data is used in precision agricultural applications via cloud computing platform. The decision-making process for field crops, horticulture, pasture and livestock has benefited

from the application of all these modern data collecting and processing tools nationwide. A number of previous studies examined the methods and uses of remote sensing in agriculture. Some research works included more than one application areas 2 while others concentrated on particular application areas like disease and pest management, evapotranspiration (ET) estimation and soil property estimation, thereby providing a calculated and precise approach to agriculture, leading to a reduced loss of resources with an increase in its usage efficacy, hence an increased yield.

Keywords: *Precision farming, information, ICT, agriculture, horticulture, AI, GPS, GIS.*

T1A-23

Concept of Organic farming for Sustainable Agricultural Development in North East Region

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Abstract

Organic farming is a crop production system that excludes use of synthetic compounds such as fertilizers, pesticides, growth regulators and livestock food additives. Basically this system minimizes the use of external inputs and aims at optimization of crop productivity rather than its maximization through renewal and strengthening of ecological processes and functions of farm ecosystems. The major domains included in organic farming are improved packages of practices, market network, organic standards and certification regulatory mechanism. The main objectives of organic farming include utilization of the available biomass of crops left in the field to enrich soil fertility, supply of balanced nutrients to the plants and improvement in the soil microbial activity, reduction in the cost of production as well as environmental pollution in eco-friendly manner that promotes Formerly Technology. The North East India has a biodiversity hotspot with many species, including more than 50 species of bamboo, 14 species of banana, 17 species of citrus, 600 orchid species, etc. Awareness in consumerism is increasing with preference to organic foods over those containing toxic chemicals posing health hazards. Food products produced from organic agriculture contain no artificial flavours, preservatives or contaminants. The consensus among consumers, though evidences are dispersed and not easily available, is that food from organic crops is tastier and healthier than those from chemically grown crops. OF promotes sustainable agriculture, the productivity of agriculture in OF is low as compared to conventional method in India. Therefore it is necessary to use suitable agro techniques for increasing the productivity of agriculture under organic farming, this may probably be attributed to nutritional properties and Sustainable Development.

Keywords: *Organic Farming (OF), Sustainable Development, North East Region*

T1A-24

Competitiveness of Organic Naga King Chilli in Peren District of Nagaland: A Policy Analysis Matrix Approach.

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Abstract

The present paper estimates the competitiveness of organic Naga King Chilli using primary data collected from 120 farmers and various traders on various aspects of the private and social cost of cultivations spread over two blocks in Peren district of Nagaland. It was observed that organic king chilli farming in the Peren district of Nagaland had competitiveness in both comparative and competitive advantage. The farmers were found beneficial both in private and social value. The altitude of government protection of agricultural outputs was found considerable low. But the protection of both the tradable and non-tradable agricultural inputs was high. Seed and fuel subsidies contribute positively on King Chilli farming. Simultaneously, the government policy on outputs and inputs does not give protection to King Chilli farming system effectively. The lack of government support intimately relates to actual price of output at the farm level, which is lower than the world price.

Keywords: *Competitiveness, King Chilli, Policy Analysis Matrix (PAM) and Nagaland*

T1A-25

Potential of Indigenous Technical Knowledge in Organic Farming in Combating with Climate Change in North-East India

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Abstract

The effects of climate change on agricultural practices are already being felt by communities worldwide. Climate change is a significant issue that requires careful observation considering their impact on food security for the local population. The extreme weather conditions due to climate change cause crop failure and reduce the opportunities of farmers for livelihood. When it comes to addressing local climate-related problems, formal scientific knowledge has historically been inadequate. Therefore, there comes the importance of applying local Indigenous Technical Knowledge (ITK). ITK is a collection of accumulated knowledge, customs, and beliefs the local community has been using in adaptation with their surroundings and one another that has been passed down to the next generations through cultural transmission. In North East India, where organic inputs are abundant and chemical fertilizers are used sparingly, ITKs are a highly practical and successful method for organic farming. The Governments of North- Eastern States have been promoting organic agriculture. Among these states Sikkim is the first in North- East as well as in whole India that has been certified as 100% organic. In the current scenario of increasing concern towards human as well as environmental health, North- East India has a lot of potential to enhance organic farming practices integrating with ITKs for retaining food security.

Keywords: *ITK; organic farming; North- East, climate change*

T1A-26

Revitalizing Natural Pig Farming in Northeast India through integration of recent advances in technology with existing Indigenous Technology Knowledge (ITKs)

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Abstract

With increasing concern about environmental pollution, drug residues, antibiotic resistance, and the ever-increasing cost of farming inputs, natural farming is once again at the forefront. Natural pig farming, emphasizing the concept of "being chemical free" and focusing on indigenous breeds/nondescript ones, has been practiced in the northeastern (NE) states of India. Typically, pig farmers in this region rear their pigs using non-conventional feed and fodder, as well as Indigenous Technology Knowledge (ITKs) for healthcare measures and general management. Pigs raised under natural farming conditions exhibit better disease resistance, produce superior quality meat, and command higher prices in the market. However, farmers rear only a few animals. Additionally, the growth rate and carcass weight of indigenous/non-descript pigs are smaller compared to exotic pig breeds. Therefore, integration of recent technological advances, such as IoT devices for monitoring animal health, automated feeding systems, and data analytics for better decision-making, would streamline farmers' work, promote the adoption of natural farming practices, and potentially encourage a transition from small-scale/marginal to large-scale farming. Additionally, marketing of piglets, fatteners, pork, and related products can be enhanced by tapping into a broader customer base through various online platforms. However, it is essential to standardize and "tag" these products as being from natural farming to differentiate them from others, establish pricing criteria, and justify the prices set. Overall, these measures would lead to increased farmers' incomes and a revitalization of natural pig farming practices.

T1A-27

Bio Products: Bio Fertilizers, Bio Pesticides, and Bio Stimulants an alternative to Agrochemicals

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Abstract

Due to increasing threats of agrochemicals on ecological imbalances, human health and soil health; organic bio products are now gaining much more importance as these bio products are not creating such disturbances in agro-ecosystem. Bio-based agricultural products, including biofertilizers and biopesticides, are gaining prominence due to their eco-friendly nature and sustainable benefits (Priya et al., 2023). Biofertilizers are organic materials like manure, compost, or fish meal that provide nutrients to plants, enhancing growth and development (Aggani, 2013). On the other hand, biopesticides are biological agents used to control pests and diseases, offering a safer alternative to synthetic chemicals (Gupta and Dikshit, 2010). In the realm of bio-based products, biofertilizers, biopesticides, and bio stimulants play crucial roles in crop protection, enhancement, and nutrition. Bio stimulants, comprising hormones, enzymes, or vitamins, contribute to plant growth and development (Priya etal., 2023). The use of bio-based products not only aids in reducing the carbon footprintbut also offers economic advantages over synthetic counterparts while ensuring superiorperformance. This approach highlights the importance of utilizing waste streams to create a more sustainable and environmentally friendly agricultural sector. In summary bio products, specifically biofertilizers and biopesticides, should delve into the

environmental benefits, economic advantages, and applications of these bio-based agricultural solutions. It should emphasize their role in sustainable agriculture, circular economy practices, and their potential to address the challenges associated with traditional agrochemicals.

Keyword: *Biofertilizers, Biopesticides, Organic farming, bio stimulants, Carbon Footprint*

T1A-28

Impact of Natural farming on different *Jhum* fallow period in Hnahthial District, Mizoram

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Abstract

Jhum cultivation involves several cultural operations to grow mixed crops on hill slopes for a year and then abandoning the land as fallow. Different *Jhum* fallow period (5 and 10 years) was selected from six location of Hnahthial District, Mizoram. Knowing the potential and importance of natural farming, its components were used at different *jhum* fallow periods. Initial and after harvest soil sample was taken to know the impact of natural farming components on soil health indicators and crop yield attributes. Soils available nutrients, bio-chemical properties and enzymes were analyzed to assess the performance of natural farming components and bio-fertilizers on different *jhum* fallow soils. Important yield attributes of paddy was also recorded to assess its performance on crop. Upland paddy seeds were treated with *beejamrutha* and CAU bio-ehancer (NPKZn solubilizer) by mixing with decomposed compost on the day of sowing. *Jeevamrutha* was sprayed by 5% in 30 days after sowing (DAS), 10% in 21 DA 1st spray for 2nd and 3rd sprays, 4th Spray when fruit/grain formation initiate. CAU bio-enhancer was also sprayed at recommended dose (1L for 40L of water) at early growth stage and before flowering. T_1 was control plots, T_2- plots receiving CAU bio-enhancer (NPKZn solubilizer), T_3- for plots receiving natural farming components (*Beejamrutha and jeevamrutha)*, and T_4 – a combination of both T_2 & T_3 treatments. As compared to the initial value, soil microbial biomass carbon (MBC), nitrogen (MBN) and phosphorus (MBP) was higher in treatment plots and found to be highest in plot receiving T_4 treatment for both the fallow years. Soil available nitrogen, potassium and phosphorus were found to be high in plots with T_2 treatment in case of 5 year jhum fallow and at T_4 treatments in case of 10 years jhum fallow, which might be due to the nutrient solubilization potential of the bio-fertilizer applied. However, Zn micronutrient was highest in T_4 plots, which receive combination treatments. Soil reaction was mostly in moderately acidic range (5.6 to 6.2) which is attributed to higher range of soil organic carbon (1.5 to 2.6%). Highest rice yield was observed in T_4 plots receiving a treatment combination of *jeevamrutha* and Bio-fertilizers (NPKZn solubilizers).

T1A-29

Enhancing soil health and biodiversity through natural farming methods: A comparative study

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Abstract

Enhancing soil health and biodiversity through natural farming methods is imperative for sustainable agriculture. This comparative study critically evaluates the efficacy of natural farming practices in improving soil quality and promoting biodiversity compared to conventional methods. By meticulously analyzing a comprehensive set of soil health indicators, including organic matter content, microbial activity, nutrient availability, and soil structure, in conjunction with biodiversity metrics such as species diversity and abundance, this research aims to offer nuanced insights into the multifaceted benefits of natural farming. Furthermore, it investigates socio-economic factors such as farmer perceptions, adoption barriers, and economic viability to delineate strategies for facilitating the transition to natural farming practices. Understanding the complex interplay between socio-economic dynamics and agricultural practices is pivotal for devising effective policies and interventions aimed at fostering sustainable agricultural systems. Through an exhaustive review of existing literature and empirical data, this study endeavors to advance our understanding of how natural farming methods can bolster soil health and biodiversity, thus laying the groundwork for more resilient and environmentally-friendly agricultural systems on a global scale. By underscoring the manifold benefits of natural farming, this study seeks to galvanize support among decision-makers and stakeholders for the widespread adoption and scaling up of these practices as an integral component of the transition towards sustainable food production systems.

T1A-30

Microbial analysis of Jeevamrutha in response to the NPKZn consortium as bio-inoculants

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Abstract

Excessive reliance on inorganic fertilizers not only deteriorates soil health but also escalates production costs. Seeking sustainable alternatives, organic bioformulations like Jeevamrutha offers promising prospects for soil enrichment and plant growth. These formulations, derived from locally available nitrogen and carbon sources, encloses a spectrum of beneficial microorganisms. However, the impact of formulation alterations on microbial development remains unclear, as does the potential enhancement through biofertilizer such as N, P, K, and Zn. To address these gaps, a laboratory experiment was conducted at the Microbial Ecology Laboratory, CPGS-AS, CAU(I), Umiam, Meghalaya. Four distinct Jeevamrutha formulations were prepared: JM(O), utilizing traditional ingredients like cow dung and urine, jaggary, virgin soil and gram flour; JM(O)+BF, enriched with NPKZn biofertilizer; JM(M), featuring soybean flour for enhanced protein content; and JM(M)+BF, supplemented with NPKZn biofertilizer. Beneficial microorganism populations, including *Rhizobium*, *Azospirillum*, Phosphate solubilizing microorganisms (PSM), and Zinc solubilizing microorganisms (ZnSM), were enumerated at 1st, 7th, and 15th days after preparation (DAP). Results revealed that *Azospirillum* (7.61 Log CFU/ml) and PSB (7.76 Log CFU/ml) exhibited a gradual increase in population up to the 7th DAP across all treatments, with the highest populations observed in JM(O)+BF. Conversely, *Rhizobium* (7.28 Log CFU/ml) and ZnSM (6.9 Log CFU/ml) populations peaked in JM(M)+BF at the 7th and 15th DAP, respectively. This suggests that the incorporation of NPKZn biofertilizer consortium enhanced the microbial load of beneficial microorganisms in Jeevamrutha formulations compared to traditional methods. These findings underscore the potential of NPKZn biofertilizer consortium, facilitating mass multiplication of beneficial microbes in farmers' fields. This approach promises to mitigate reliance on costly biofertilizers, offering a sustainable strategy for improving soil health and agricultural productivity.

Keywords: *Jeevamrutha, Biofertilizer, Azospillium, Rhizobium, PSM, ZnSM*

T1A-31

Assessing the influence of natural farming practices and biofertilizers on crop yield and soil quality in Ri-Bhoi District Meghalaya

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Abstract

India is a country with a diverse climate and natural resources; thus, it mainly relies on agriculture to deal with the current demographic issue. With regards to agriculture in particular, natural resources must be conserved without being squandered. Natural farming is based on the principles of agro-ecology, which emphasizes minimizing stress on the production system and using eco-friendly practices, both plant and soil health for long-term results without affecting soil quality, biodiversity, or the overall quality of environment. *Beejamrutha* (seed treatment), *Jeevamrutha* and *Acchadana* (mulching) are the main components under natural farming which helps in growing the crop without disturbing the environment. CAU-Bioenhancer, is the native biofertilizer which helps in improving the microbial community in the soil. A study has been done in COA research farm with four different crops (Buckwheat; Garden pea; Linseed and Potato) along with the combination of natural farming components with bioenhancer. T_1-*Beejamrutha* + *Jeevamrutha* + Biofertilizer; T_2-*Beejamrutha* + *Jeevamrutha* + *Acchadana*; T_3-*Beejamrutha* + *Jeevamrutha* + *Acchadana* + Biofertilizer; T_4- Control are the four different treatment combinations on four different crops. Among the four treatments T_3 has shown significant difference in soil parameters (N, P, K and Zn; 338.5±3.8 kg/ha, 45.1±0.75 kg/ha, 288.7±5.33 kg/ha and 0.45±0.02 ppm) as well as plant parameters (Buckwheat- no. of flowers/plant; no. of grains/flower; Garden pea- no. of pods/plant; no. of grains/pod; Linseed- no. of primary branches; no. of capsules/plant; Potato- no. of tubers/plant) and nutrient uptake. Enormous increase in the plant biomass with T_2. But T_3 has recorded the highest yield in all the four crops (Buckwheat-12q/ha; Garden pea-14q/ha; Linseed- 11q/ha; potato-225q/ha) compared to the rest of the treatments followed by T_2. Hence the addition of bioenhancer to the natural farming components shows effective result on soil quality and yield of different crops.

Keywords: *Natural farming, Biofertilizer, Soil quality and Nutrient uptake*

T1A-32

Dynamics of Manganese Fractions in Rice Soil as Influenced by Different Biochar Application and Moisture Regimes

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Abstract

An investigation was carried out to study the "Dynamics of manganese as influenced by biochar application on rice soil" during 2022 at Department of Soil Sciences, Assam Agricultural University, Jorhat. Adsorption isotherm study was performed to know the manganese (Mn) adsorption characteristics of biochar. Incubation experiment was also conducted to know the effect of different biochar (rice husk biochar (RHB) and bamboo biochar (BB)) and its level (0, 3 and 5 % (w/w)) on dynamics of Mn in soil under selected phytotoxic level (250 mg kg^{-1}) at two moisture regimes (continuously waterlogging (CW) and continuous saturation (CS)). Twelve treatment combinations under spiked Mn concentration and one control were used and replicated thrice by adopting factorial completely randomized design with single control. The adsorption isotherm data was well fitted to both Langmuir's and Freundlich isotherm models. The maximum adsorption capacity (G_{max}) of RHB for Mn^{2+} was observed to be 11.31 mmol kg^{-1}, whereas BB had 13.71 mmol kg^{-1} for Mn^{2+}. In equilibrium state, removal efficiency of Mn^{2+} by rice husk biochar and bamboo biochar were 73 and 74%, respectively. In an incubation experiment, application of BB, CW and 5% biochar level recorded significantly higher soil pH at different incubation intervals. Irrespective of incubation interval, rice husk biochar application, continuous waterlogged moisture regime and 5% biochar level recorded significantly higher adsorbed and dissolved Si. Application of BB, CS and 5% biochar level recorded significantly lower DTPA-Mn and among different treatment interactions, application of 5% BB in CS moisture regime recorded significantly lower DTPA-Mn in soil. In respect of fraction of Mn, different moisture regime, biochar and its levels significantly decreased soluble + exchangeable and oxide bound Mn fractions and increased carbonate and organic matter bound Mn fractions under spiked Mn concentration. However, residual fraction of Mn did not influence with biochar application and moisture regime. The RHB application at 5% level in CS-MR under spiked Mn concentration significantly decreased the DTPA-Mn, soluble plus exchangeable, oxide bound and residual fraction of Mn, but, on the other hand, significantly increased the carbonate bound and organic matter bound fractions of Mn and Mn in soil. These findings suggest that continuous saturation with rice husk biochar application at 5% level in the Mn contaminated soil, significantly decrease the availability of Mn in soil as well as from different solid phases, hence, it could be a farm level viable technique to manage Mn toxicity in low land rice cultivation.

T1A-33

Effect of Zinc Based Fertilizer in Combination with Zinc Mobilizing Bacteria and Jeevamrit on soil health of Maize crop

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Abstract

The present investigation entitled Effect of Zinc based fertilizer in combination with Zinc Mobilizing Bacteria and Jeevamrit for soil application under Maize crop was carried out at Student's Instructional Farm of Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya (U.P.) during *Kharif*, 2021. The nine treatments viz., T_1: RDF 100%,T_2 : RDF + 2.5 kg Zn ha^{-1} (Zinc Sulphate),T_3: RDF + 5.0 kg Zn ha^{-1} (Zinc Sulphate), T_4: RDF + 2.5 kg Zn ha^{-1}(Zinc Oxide), T_5 : RDF + 5.0 kg Zn ha^{-1} (Zinc Oxide), T_6: RDF + ZMB (Zinc Mobilizing Bacteria) + Jeevamrit @ 200 l ha^{-1}, T_7 : RDF + 5.0 kg Zn ha^{-1} (Zinc sulphate) + ZMB + Jeevamrit @ 200 l ha^{-1},T_8 : RDF + 5.0 kg Zn ha^{-1} (Zinc Oxide) + ZMB + Jeevamrit @ 200 l ha^{-1}, T_9 : RDF + 2.5 kg Zn ha^{-1} (Zinc sulphate) + 2.5 kg Zn ha^{-1} (Zinc oxide) + ZMB +Jeevamrit @ 200 l ha^{-1} were comprised in Randomized Block Design with three replication. Spacing between row to row and plant to plant were 60 and 20 cm, respectively. The highest organic carbon, Available Nitrogen, Phosphorus, Potassium, Zinc and CEC were recorded with the combine application of treatments (T_9) and minimum bulk density (1.36 Mg/m^3) was observed with the combine application of treatments (T_9). For assessing soil health some important biological parameters also taken that is, Microbial Biomass Carbon, soil Dehydrogenase and Soil microbial population were observed maximum with the application of treatments (T_9 : RDF + 2.5 kg Zn ha^{-1} (Zinc sulphate) + 2.5 kg Zn ha^{-1} (Zinc oxide) + ZMB +Jeevamrit @ 200 l ha^{-1}).

Keywords: *Jeevamrit, zinc mobilizing bacteria, zinc based fertilizer, soil health*

T1A-34

Development of herbal pesticide enriched liquid manure

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Abstract

"Ovaneem" represents a breakthrough in sustainable agriculture, offering a solution to the pressing challenges posed by conventional chemical pesticides. This herbal pesticide-enriched liquid manure is meticulously crafted to combat agricultural pests while nurturing soil health and fertility. By blending traditional herbal extracts with organic components, Ovaneem provides farmers with a potent yet eco-friendly alternative to chemical pesticides. The formulation targets a broad spectrum of pests, promoting crop yields while safeguarding beneficial organisms and ecosystems. This innovation is particularly significant in regions like the North-Eastern Region of India, where agricultural productivity is hampered by acidic soil and nutrient deficiencies. Here, the adoption of organic farming practices, supported by the efficient utilization of bio-degradable materials from livestock and poultry farming, can revolutionize agricultural sustainability. The technology behind Ovaneem involves the conversion of organic waste into liquid manure enriched with herbal pesticides. Through a multi-step process, including biogas digestion and liquid-solid separation, organic waste is transformed into a valuable resource for pest management and soil enrichment. The liquid fraction, combined with herbal pesticides like Akand, Neem, and ashwaganda, enhances its efficacy in pest control while providing essential nutrients to the soil. Concurrently, the solid waste undergoes vermicomposting to produce vermicompost, further enriching the soil with nutrients. This integrated approach not only addresses organic waste management challenges but also promotes soil health and sustainable agriculture. Through proper branding and packaging, Ovaneem is positioned as a viable and marketable product, facilitating its adoption by farmers. By optimizing bio-waste utilization and integrating herbal pesticides into liquid manure production, this technology aims to boost agricultural productivity, promote organic farming practices, and mitigate environmental degradation. Ultimately, Ovaneem seeks to establish a resilient and ecologically sustainable agricultural system in the North-Eastern Region of India, fostering socio-economic development and environmental stewardship in the region.

Key words: *Ovaneem, Herbal pesticide, Liquid manure, Composting*

T1A-35

Understanding traditional ecological knowledge relating to bioindicators associated in weather forecasting in Northeast India: A systematic review

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Abstract

The tribal communities in Northeastern part of India mainly depend on agriculture for their livelihood. In the course of time, they have developed their own weather forecasting system basedon different bio-indicators, atmospheric changes and phenological indicators. The bio-indicatorswere primarily based on the recognition of unique situations, the behaviours of insects, birds and mammals, characteristics of plants, and location, timing and patterns of clouds, lighting, wind and celestial bodies. The North-eastern region is made up of eight states: Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura, each with its own TEK and distinct bioindicators. However, these acquired knowledge is still not documented and validated with sufficient climatic and meteorological observations. In this paper, we have reviewed the literature relating to traditional weather forecasting system developed by tribal communities in Northeast India. It was found that knowledge of this traditional weather forecasting helped the farmers to predict forthcoming weather conditions and increase their farming resiliency. This study recommends the policymakers, academicians and research institutes to collaborate with communities to integrate traditional knowledge with scientific weather forecast systems while designing weather forecasting service for farming communities.

Keywords: *Traditional Ecological Knowledge, Weather forecast, bio-indicators, Northeast India*

T1A-36

Challenges faced by farmers towards organic agricultural activities initiated by the Department of Agriculture, Government of Assam

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Abstract

Organic agriculture represents an ecological approach to production management, minimizing reliance on chemical fertilizers, pesticides, and growth regulators. By doing so, it fosters biodiversity and enhances soil fertility. Recently, organic farming has garnered significant attention for its eco-friendly practices and associated health benefits. Traditionally, Assam has been an agrarian state, with approximately 70% of its population dependent on agriculture for their livelihoods. Blessed with fertile land and favourable climatic conditions, Assam presents an ideal environment for

farmers to embrace organic farming, especially given the expanding global organic market. This paper focusses on the substantial challenges faced by the organic farmers in Assam. Therefore the study was carried out in Jorhat district of Assam with a total of 60 farmers selected as respondents for the study. Among the personal problems lack of family support was ranked as the most important challenge to be faced by the farmers, among the input availing problems, lack of availability of high quality organic seeds was the important challenge faced by the farmers with PCI 158. Lack of proper brand building and advertisement was ranked as the most important challenge among the infrastructure related problems with PCI= 164. Lack of exposure of the high quality organic products of Assam both Nationally and Internationally was the important challenge among the market related challenges with PCI= 169. Also, the Government of Assam, in collaboration with the Indian government, has launched numerous initiatives to promote organic farming in the state. Programs such as the Paramparagat Krishi Vikas Yojana (PKVY) and Mission Organic Value Chain Development (MOVCD) signify concerted efforts towards positioning Assam as a hub for organic agriculture.

T1A-37

Indigeneous Technical Knowledge (ITK) based Integrated Pest Management (IPM) in Organic Farming

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Abstract

Organic farming is a comprehensive approach to production management that aims to improve the health of the agro-ecosystem by promoting biological variety, biological circles, and soil biological activity. ITK based organic formulations offers essential support for sustainable development and useful suggestions for the economical utilization of natural resources. Using ITK-based crop protection techniques not only helps to restore the biodiversity of natural enemies but also serves as an alternative to pesticides. The process of creating indigenous knowledge (IK) systems involves several generations of experience, close observation, and trial-and-error research. Stories, songs, folklore, proverbs, dances, myths, cultural values, beliefs, rituals, community laws, local languages, agricultural techniques, equipment, materials, plant species, and animal breeds are just a few examples of how ITK are expressed and preserved in people's memories and daily activities. It has been attempted to review the ITKs that are common in various North Eastern regions of the nation, as well as the technologies that various communities have adopted and used, many of which may be in danger of going extinct. Technologies that are more need-based, better at solving problems, regionally applicable, readily accepted, eco-friendly, and more comprehensible and credible will be developed with the aid of ITK and scientific knowledge. These technologies will also be more persuasive to farmers.

Key words: *Organic Farming, ITK.*

T1A-38

Effect of enriched biochar on yield performance of toria (*Brassica campestris* L)

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Abstract

Toria (*Brassica campestris* L) is important oilseed crop in the North Eastern Hill Region. Present work has focused on effect of enriched biochar on yield performance of toria during the *rabi* season of 2023-24. The field experiment was conducted at Biswanath college of agriculture, Assam Agricultural University, Biswanath chariali, Assam. Enriched biochar and biochar were added to toria crop at rates of 2 tonnes ha^{-1} and 0.6 tonnes ha^{-1}, respectively. Biochar is a carbon rich source which is produced by converting bamboo biomass in the presence of limited oxygen through pyrolysis at a temperature range of 350-650^{o}C. Enriched biochar is prepared by using biochar and FYM with a ratio of 1:9. Enriched biochar used for improving soil properties & plant nutrition such as increase water holding capacity, total soil porosity, soil aggregation and availability of plant nutrients. It helps in carbon sequestration. The no. of silique per plant, no. of grains per plant, test weight and yield of toria in FYM enriched biochar treated soil at the rate of 2 tonnes ha^{-1} was significantly increased by 23.27 percent, 37.53 percent, 42.96 percent and 45.07 percent, respectively over control. Biochar application @ 0.6 tonnes ha^{-1} significantly higher values of no. of silique per plant, no. of grains per plant, test weight and yield of toria were recorded, which was 15.84 percent, 20.39 percent, 23.30 percent and 36.20 percent, respectively compared with control. Addition of Enriched biochar @ 2 t ha^{-1} enhance yield attributes like no. of silique per plant, no. of grains per plant, test weight and yield of toria was observed 6.40 percent, 14.20 percent, 15.96 percent and 6.50 percent higher than application of 0.6 t ha^{-1} biochar alone.

Keywords: *Enriched biochar, Biochar, carbon sequestration*

T1A-39

Biochar Production from Agricultural Crop Residues and Its Utilization for Conservation of Environment

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Abstract

Biochar is an incredibly versatile material that can be produced from agricultural crop residues through various thermochemical conversion technologies. These technologies are utilized at domestic level for small scale biochar production by the farmer for agriculture utilization as well as at large scale production of biochar for energy production. The biochar produced from the agricultural crop residues can be used for different purposes such as soil amendment, carbon sequestration, Waste water treatment, air purification, carbon sequestration, energy production and as catalyst. The production of biochar from agricultural crop residues presents a promising and sustainable solution to address numerous challenges we currently face. By valorizing massive quantities of available 288.14 MT (33.15%) of surplus residue for biochar production offers a novel approach to resource management, moving away from practices that contribute to air pollution and greenhouse gas emissions. Moreover, biochar serves as a vital tool in mitigating climate change by acting as a long-term carbon sink when applied to soils. Its stability and recalcitrant nature allow it to effectively sequester atmospheric carbon dioxide, aligning with global efforts to combat climate change. Furthermore, biochar exhibits unique physicochemical properties that enable it to remediate environmental pollutants from soil, water, and air, addressing pollution challenges effectively. Additionally, its use enhances soil fertility, water retention, and microbial activity, promoting sustainable agricultural practices while reducing dependency on chemical fertilizers. Overall, the conversion of agricultural waste into biochar exemplifies the principles of a circular economy, promoting sustainable resource utilization and waste minimization.

T1A-40

Comparative evaluation of natural farming nutrient management packages with other organic management practices on soil and crop health in acid soils

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Abstract

Intensive use of chemical inputs adversely affect the soil health and the environment which is a treat to soil resources therefore it is important to protect the soil health by practising chemical free farming methods like natural (NF) and organic farming (OF). In order to evaluate natural farming nutrient management packages with other organic management practices on soil and crop health, a field trial was conducted at experimental field of ICAR Research Complex for NEH Region, Umiam with treatment combination consisting of T_1 (Control): Traditional/Farmers' practice (organic-FYM), T_2: Natural Farming, T_3: POP organic (FYM + Biofertilizer (specific to crop) + Lime), T_4: NF + Lime, T5: NF + Vermiwash/Compost wash (foliar spray), T_6: Biofertilizer/Consortia + Lime + FYM (OF), T_7: Mulch (crop residue) + Lime + FYM (OF). Finger millet and cowpea as intercrop was sown at a ratio of 4:2 during the field trial. The Experiment was laid out in randomized block design with seven treatments and replicated thrice. The soil analysis after the harvest of the crop revealed that the soil organic carbon (SOC) content ranges from 1.07-1.35%, available nitrogen (N) is 213-263.4 kg/ha, and available phosphorus (P) 29.28-36.27 kg/ha. Among all the treatment conducted it has been observed that in finger millet in treatment T_5 recorded the highest yield of 1.38-1.97 t/ha and T_2 recorded the least, and in Cowpea treatment T_7 recorded the highest yield of 0.75-3.28 t/ha and T_2 recorded the lowest. Thus, it can be concluded that practicing of NF management practices along with foliar spray of vermiwash helps in improving the yield of finger millet, and mulching of crop residue along with application of agriculture lime and FYM boost the yield of cowpea

Keywords: *Natural farming, Acid soil, Soil health, Finger millet*

T1A-41

Unlocking Nature's Secrets: Harnessing traditions for accurate weather forecasts

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Abstract

Rainfall is an essential necessity for all living entity, playing an indispensable role in the sustenance of ecosystems. Keeping in view of significant influence of rainfall on agriculture sector, precise prediction of rainfall forecast is very essential (Parashara, 4th Century BC). *Panchangam*, a traditional Hindu almanac, has been prepared for public use since the *Vedic period* (1400-1300 BC) and has historically served as a tool for various purposes, including the prediction of rainfall (Sivaprakasam & Kanakasabai, 2009). The exploration and study of this type of discipline emphasizes the urgent need for collaboration between meteorologists and astrologers to propel the development of more reliable weather

forecasting techniques (Seetaramayya et al, 2002). Focusing on data from the College of Horticulture, Mulade (MS), positioned at Latitude 16.02° N, Longitude 73.04° E and an altitude of 35 meters, over a decade, examines rainfall patterns. The observed rainfall ranges from 2381.5 mm to 4591 mm, exhibiting notable fluctuations (extremes). The lowest precipitation was noted during *Manmath Savatsar* (2015-16), where Venus seted and retrograded in *Magha*. Conversely, the High rainfall was observed during *Vikruti Savatsara* (2010-11), when Jupiter was in Pisces while Venus was in Cancer. This investigation underscores the importance of interdisciplinary cooperation in advancing more precise rainfall predictions, thereby strengthening agricultural planning and resource management. By integrating traditional wisdom with modern scientific approaches, this study endeavors to contribute to the development of robust methodologies for forecasting rainfall, crucial for promoting sustainable agricultural practices amidst evolving climatic conditions.

Keywords: *Rainfall, Panchagam, Savatsara, Astrology, Meterology*

Theme 2; Agrobiodiversity and Ethnobotany- Conservation, utilization and valuation

T2A-1

Low Glycemic Index (GI) Puffed Black rice cereal: Formulation, Optimization, Quality analysis and Storage studies

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Abstract

The aim of this research is to study the physico-chemical, puffing time, sensory and storage studies of the puffed black rice cereal bar (PBRCB) prepared from puffed black rice, roastedsunflower seeds, cinnamon powder, and brown rice syrup (BRS). The physico-chemical properties like hardness, color values 'L', 'b', 'a' and overall acceptability of the bar was evaluated. The moisture content, hardness, peroxide value, free fatty acids (FFA), and color of PBRCB packed in aluminium coated laminate (ACL) were analyse for a period of 4 months. The hardness and color 'L' and 'b' values significantly affected by the popping time and BRS level with an optimum level of 1.5 min and 50% respectively. In storage studies, the parameters i.e., hardness and FFA was significantly affected by the packaging method, storage time but was within the permissible limit. ACL with vacuum sealing gives better quality of PBRCB as compared to hand sealing.

Keywords: *Black rice cereal bar, puffing time, brown rice syrup, hardness, storage studies*

T2A-2

DNA Barcoding and its role in conservation of biodiversity

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Abstract

DNA barcoding plays an important role in the evolution of biodiversity and to keep an eye on the international trades in many rare species. It can also act as biosecurity in trafficking of economically precious things or controlled species. DNA barcode also utilized to assess those species that are taxonomically different both the native and invaded species. Barcode sequences can be retrieved from barcode of life data systems (BOLD) database—comprises of online database of reference DNA sequences used to compare with unknown DNA sequence of some organism. There are a range of cloud-based platforms and tools that are freely available to analyse High Throughput Screening data. This database is a repository of species-specific nucleic acid sequences, images specimens and other trace files. Mutation rate in these regions must be at least>2% such that sufficient difference will be established. The universal primers designed to these regions i.e., flanking regions must be conserved, as they must be similar in all species. In addition, there must be low rate of recombination and high rates of molecular evolution. Applications of these diverse classes of species-specific markers to target the specific DNA fragments of genome aim to assess community structure and phylogenetic diversity to further refine taxonomic hierarchy. Barcoding approaches are mainly established by the use of molecular operational taxonomic units to distinguish between intra and inter-specific species variation. Initially used as an identification tool, DNA barcoding is now applied in the industrial quality assurance context to identify herbal products and its conservation. DNA barcoding can contribute to conservation policy in two important ways: by speeding up local biodiversity assessments to prioritize conservation areas or evaluate the success of conservation actions, and by providing information about evolutionary histories and phylogenetic diversity.

Keywords: *DNA barcoding, Database, Evolution and Phylogenetic Diversity*

T2A-3

Assessment of Dual Purpose *Bao* Rice (*Oryza sativa l.*) Varieties of Assam for Fodder and Grain Yield

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Abstract

Bao rice is particularly well-suited for growing in flooded conditions. When the water level rises, they grow longer and produces higher yield. In light of this, during the 2022 kharif season, a total of 15 genotypes of bao rice were assessed at ICR Farm, Assam Agricultural University, Jorhat-13, using a randomized block design. Three cuttings were provided during the growth period. Pooled analysis showed that plant height, crude protein content, and green forage yield have a significant genotype × cutting interaction. Genotypes at 1st cut (65 DAS) exhibited maximum crude protein and ash content; however genotypes at 3rd cut (125 days) exhibited maximum crude fibre content. With an increase in cutting interval, the crude protein and ash content tend to decrease, while for crude fibre content it increases. Thus, it shows that the genotypes of the traits being studied are significantly influenced by detopping. Genetic variability analysis reveals high PCV and GCV for grain yield. High heritability along with high genetic advancement was shown by the traits: green forage yield, dry matter yield, tillers per plant, panicle length, flag leaf length, flag area, crude protein content, and grain yield, suggesting that these traits were therefore controlled by additive genes. Plant height, tillers per plant, panicle length, panicle per plant, flag leaf length and area, grains per plant, dry matter yield, and grain yield per plant were found to be positively correlated with both green forage yield and grain yield. Maximum direct effect on green forage yield per plant was exhibited by flag leaf length followed by dry matter yield and plant height. Panikekua, Buruli, Kola, Tulsi, Kekua, and Pagrow *bao* are determined to be promising for dual purpose based on mean performance; thus, more research in many places would be required for enhancement of these high yielding, dual purpose genotypes.

Keywords: *Bao Rice, Cutting, Green Forage Yield, Grain Yield, Crude Protein, Crude Fibre, Ash Content, Genetic Variability*

T2A-4

Current Scenario of Milk Production in the Northeastern States of India: Challenges and Mitigation Strategies

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Abstract

The livestock sector plays a vital role in the economy of Northeastern (NE) states, particularly in rural areas; however, its full potential remains largely untapped. Dairy is an integral part of livestock sector. Total milk production in the region was 1.608 million tonnes in 2022-23, accounting for only 0.70% of the country's milk production during the same year (230.58 million tonnes). The compounded annual growth rate (CAGR) of milk in the NE state was 1.59% over the previous year (2021-22), which was significantly lower than the national average of 3.83%. Among all NE states, Tripura has registered the highest CAGR in milk production (5.2%), followed by Meghalaya (3.51%), Assam (2.42%), and Sikkim (0.01%). The states with the highest negative growth in milk production were Nagaland (-23.20%, Manipur (-5.12%), Arunachal Pradesh (-1.03%), and Mizoram (-0.45%) in 2022-2023 compared to the previous year. Per capita milk availability in NE states is significantly lower than the all-India level (459 g per day), as well as the recommended value of 300 g per day by the Indian Council of Medical Research (ICMR), except for the state of Sikkim. The per capita availability of milk in Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura was 81, 78, 62, 77, 55, 61, 347, and 153 g per day during 2022-23, respectively. Low milk production in NE states is attributed by multifactor's challenges like low productivity of dairy animals, inadequate feed and fodder availability, limited cold storage facilities, underdeveloped cooperative structures, and poor veterinary healthcare services including artificial insemination (AI) facilities. These challenges could be mitigated by proper strategies, such as state-specific breeding policies, augmentation of feed and fodder production, development of dairy processing and cold storage facilities, strengthening of veterinary services, capacity building of farmers, encouragement of private sector investments, and improvement of road connectivity, which can unlock this potential and contribute to improved livelihoods, enhanced food security, and socio-economic development in the region.

T2A-5

Conservation, Valuation, and Utilization of Diversified Citrus Crops in NE states of India

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Abstract

The North-eastern region of India is a treasure of various Citrus species, a vast reservoir of Citrus diversity exists in wild, semi wild form and is found scattered here and there without commercial cultivation and much care. The edaphic and climatic set up as well as the physiographic condition of the region makes it possible to grow a number of species, landraces and probable hybrids of Citrus. But of now with the population increase, changing attitude of the farmers

towards some newly introduced cash crops leads to genetic erosion of the valuable resources and most of them are in verge of extinction. So, it is the high time for the scientific community to exploit all the rare and endangered resources of Citrus of north eastern region and for their conservation. In addition molecular and morphological characterization of the reported germplasm, evaluation and screening against biotic and abiotic stresses should also be needed to safeguard the existing population of Citrus and for future Citrus improvement programme. While diversification can mitigate risks and foster agricultural sustainability. Considering the influences of complex risks and farmers' subjective risk aversion, the decision for small-scale farmers to specialize in citrus cultivation or diversify with multiple crops remains uncertain. There is currently limited understanding of this issue among citrus smallholders in rural parts . This study aims to fill this empirical gap by examining the impact of smallholder farmers' subjective risk. Embracing the diversity of citrus crops, varieties, and agricultural systems is essential for building sustainable food systems that can adapt to changing environmental and socio-economic conditions.

Keywords: *Citrus, Diversity, Genetic resources, Germplasms, Population.*

T2A-6

Biodiversity of medicinal plants in tripura and their utilization, problems and conservation

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Abstract

Our state is endowed with very rich flora and fauna and rich biodiversity, which is under increasing threat from biotic and abiotic factors. The agroclimatic conditions of Tripura favour the cultivation of diverse medicinal plants and is considered to be the hot-spot of medicinal plants and has in abundance, diverse range of herbs, shrubs, trees and vines that have important medicinal value whose healing properties are known to the local healers and practitioner. The rural peoples are suffering from common ailments like cuts, wounds, blisters, itching, eczema, skin disease, sores, scabies, swelling, cold, fever, cough, diarrhoea, asthma, diabetes, jaundice, leprosy, hiccough, bronchitis, routine skin and eye irritations, veterinary healers etc. Tripura being one of richest centres of biodiversity, more than 270 species medicinal plants have been identified for their medicinal uses, which make Tripura a unique position in traditional systems of medicine. The indiscriminate collection of medicinal plants from forest led to depletion and extinction in many valuable plants, cases making them as rare endangered and threatened species. The threats to biodiversity conservation is due to deforestation, high population growth, urbanization, shifting cultivation, grazing, illegal extraction of medicinal plants, forest fires etc. There are number of wild and traditional medicinal plant species which are yet to be identified and documented in the state. It is highly necessary to document those medicinal plants and take efficient steps to conserve them. Therefore, adequate endeavours are needed for conservation of such invaluable biodiversity and for their sustainable use.

Key word: *Biodiversity, Medicinal plants, conservation, Problems, Tripura.*

T2A-7

Vermicomposting: An efficient way of crop residue recycling for fetching gold from garbage

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Abstract

Crop residues play a significant role in the cycling of nutrients. One of the simplest ways to recycle crop wastes is by vermicomposting, which turns waste into valuable material. Earthworms are utilized in the vermicomposting process, which turns organic waste (crop leftovers) into the black gold that is known as vermicompost. A species must meet certain biological and ecological requirements in order to be considered appropriate for vermicomposting. These requirements include the capacity to naturally colonize organic wastes, high rates of organic matter consumption, tolerance for a wide range of environmental conditions, high rates of reproduction through the production of a large number of cocoons that should hatch quickly, and rapid rates of growth and maturation from hatchlings to adult individuals. In light of this, an experiment was carried out at the College of Agriculture, Kyrdemkulai in 2023 to prepare vermicompost using three distinct substrates: weeds (horse weed), bamboo leaves, and paddy straw. For the purpose of producing vermicompost in large quantities, five treatments (T1: 100% paddy straw, T2: 100% bamboo leaves, T3: 100% horse weed, T4: 75% Paddy Straw + 25% Horse Weed, and T5: 50% Paddy straw + 50% Horse weed) have been administered in various pits. This experiment examined the ability and/or efficacy of epigeic earthworms (Eisenia foetida) to compost, with the goal of turning the aforementioned agricultural waste into valuable wealth (vermicompost). The main objective of this study was to find out the effect of stocking density on substrate mineralization, earthworm proliferation ratio (total earthworm number at the end of the process to the total earthworm number at the beginning of the process), converting factor efficiency (total substrate weight at the end of the process to total substrate weight at the beginning of the process) of earthworm, and composting duration (maturity period of the vermicompost). This study

indicated that T4 had the greatest earthworm growth ratio and converting factor efficiency, followed by T5 and T1. Conversely, T3 and T2 had the shortest composting times (75 days) and longest (115 days), respectively. As a result, this study suggested that, in order to produce vermicompost under Meghalaya's rainfed circumstances and for effective agricultural waste recycling, a combination of horse weed and paddy straw might be taken into consideration.

Key words: *Vermicompost, Converting factor efficiency, earthworm proliferation ratio, stocking density*

T2A-8

Prospects of Expansion of Area under Millets in Hilly Ecological Tracts of Meghalaya

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Abstract

Millets are considered a traditional stable food around the world primarily for dryland regions. Millets are also known as nutri-cereals for achieving nutritional security. They are considered as superfoods from a nutrition point of view and show greater resistance to apparent weather conditions making them climate-resilient crops. In Meghalaya millets are still usually grown in the jhum or shifting cultivation fields where seeds are broadcasted during the sowing season. The seeds are traditional seeds which have been preserved by custodian farmers. According to the Directorate of Agriculture, Government of Meghalaya in 2017-2018 the starchy staples cultivated in Meghalaya are rice, wheat, maize, millet, potato, sweet potato, and tapioca. Among them, millet is an important crop that has been traditionally grown by the indigenous communities of Meghalaya since a very long time. There is evidence to suggest that the local indigenous community i.e., the Khasis were growing millets (commonly known as krai) since the late 19th Century. Since the Khasis are an ancient group of the Indian sub-continent and millets were probably first cultivated in Asia more than 4000 years ago, it is highly probable that cultivation of the crop is a very old practice. The annual Millet Festival is traditionally celebrated by the millet-growing communities in Nongtraw village, Khatarshnong, Meghalaya. Due to decline in the production the festival is almost forgotten. The drudgery, high labour cost, lack of millet processing unit and institutional support were the main reasons behind the decreased millet production. Moreover, there is a wide yield gap between the realized yield potential of high yielding varieties and the harvestable yield from the fields of the farmers. To make aware of the high yielding varieties, improved production technologies and integrated pest and disease management among the farmers, large scale demonstrations combined with group discussion and skill transfer trainings will be more rewarding. To support genetic diversities, a thorough local recording process is necessary. Additionally, by assisting with heritage conservation, this strengthens the local populations' resilience. We can also encourage farmer-producer organizations (FPOs) to pursue value-adding and marketing in order to increase productivity. Profitability is raised when group efforts under the FPOs lower input costs overall. Raising awareness about millets' health advantages is necessary. Encouraging local youth to engage in entrepreneurship and millet-based agribusiness, as well as utilizing e-commerce, media, local social organizations, tourism, and other means, is crucial in facilitating these developments. Promoting research and extension activities on millets will facilitate exchange of innovative practices between farmers and scientists as well as it provides the wav forward in bringing millets into the agricultural policies of the State "Meghalaya" in particular and North Eastern Hilly Region as a whole.

T2A-9

Ethnobotany for futuristic agriculture in North-East India

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Abstract

North-East India is bestowed with immense richness of agro-biodiversity. Much of the region's agro biodiversity is in the custody of farming communities and tribals who have followed age old farming practices. However, since traditional agricultural systems were finely interwoven with the social and cultural fabric of villages, as also with the forests and other ecological features within which the villages existed, they could not withstand the far-reaching changes in land-use, taxation, and administrative structures brought about by the new age development. Issues like loss of indigenous knowledge, intellectual property right, uncontrolled transboundary trade of plants are common problems in these resource areas. The interdisciplinary science dealing with the direct relationship between flora and Humans called as Ethnobotany holds a huge potential in helping with utilisation and valuation of the agro-biodiversity of the region. Ethnobotanical studies have value not only for the consumers & researchers, but as a way of catalysing awareness of the value of biological diversity and support for its conservation. Policy makers, by skilfully analysing the plant-human relationship can initiate for a better, sustainable and ecologically balanced environment looking at the current worsening condition of the Earth. This paper reviews the role of ethnobotanical approaches with an emphasis on the conservation of traditional knowledge and plant genetic resource. An array of possibilities for the development of agriculture in North-East India with the help of ethnobotanical studies have been discussed ahead.

T2A-10

Agrobiodiversity and Ethnobotany: A Synergy for Sustainable Agriculture

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Abstract

Agrobiodiversity encompasses the variety of life forms, from genes to ecosystems, associated with agriculture. This includes domesticated plants and animals, their wild relatives, and the beneficial organisms that interact with them. Ethnobotany, on the other hand, bridges the gap between human cultures and plant life. It studies the traditional knowledge and practices related to plant use for food, medicine, and other purposes. The synergy between agrobiodiversity and ethnobotany offers valuable insights for sustainable agriculture. Traditional societies have cultivated and managed a vast array of plant varieties, fostering resilience in agricultural systems. Ethnobotanical studies document this knowledge, revealing the potential of underutilized crops and forgotten plant uses. This information can be used to: Diversify cropping systems: By incorporating a wider range of plant species, farmers can reduce pest and disease outbreaks and improve soil health. Identify new food sources: Traditional knowledge can lead to the discovery of underutilized or forgotten crops with high nutritional value. Develop new medicines: Ethnobotanical studies have played a crucial role in the discovery of numerous plant-based medicines. Enhance ecosystem services: Integrating traditional practices that promote beneficial insects and pollinators can contribute to a more balanced agroecosystem. However, the erosion of traditional knowledge and the loss of biodiversity threaten this valuable synergy. By combining scientific research with ethnobotanical knowledge, we can ensure the sustainable management of our agricultural landscapes and the preservation of this rich cultural heritage.

T2A-11

Altitude Extension: A futuristic Extension Approach

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Abstract

The onset and growth of extension strategy has so far been in a response to the socio-economic milieu across the World. Extension education, by becoming both system and function for technology socialization, can't go without geographical references. With a change of altitude and slope, the panorama of biology and sociology keeps transforming. What is happening since past and till today is a kind of blanket extension recommendations is being made to cover all geographical variations along and across the slope or terrains in a given hill ecosystem. This can neither be flexible, nor be precised in redressing the geography specific technological problem or sociology specific issues. The North East Hill eco system of India is blessed with bounty of nature and is one of the hot spots of the World. At every curve of the hills, there is music of nature and ripples of culture, that characterize it in an altitude reference and geographical distribution and hence, the altitude of a hill becomes a major character itself in deciding on strategy of extension. The entire slice of the research in Manipur, a small state in North East India has divided the terrain into high, medium and low altitude in three selected districts to elucidate the altitude specific factors impacting on the crop stands, yield behavior, attitudinal behavior, technological options and market responses etc. The variables like Age, Education, Family type, Household type, Housed owned, Ethnic Group, Clan, Occupation, Child Health, Public Distribution System, Transport, Modern Household Assets, Farm size, Energy used behavior, Source of Power in the house, Social Participation, ITKs and TEK, Communication channel(AKIS),Transfer of technology (Time line), Extension Approach (Time line), Extension activities (Time line), Net income of Enterprises, Biodiversity Index, Carbon Sequestration, Soil Parameters, have rightly indicated that there is distinct altitudinal impact on differential behaviors of techno-social character and hence, strongly merit an altitude specific techno-managerial intervention vis-à-vis extension strategy. The empirical study has elicited a unique pattern of altitudinal change in terms of altitude impact on crop husbandry, bio-diversity score, livelihood pattern, attitude and situation specific need perception for a sustainable and comprehensive agro-economic development in this unique ecosystem of the World. This piece of work so far can be reckoned the first of its kind in this sub-continent. With this innovative approach, Altitude Extension, the first of its kind in extension domain, has attempted to include the variations along with the altitude of a hill ecosystem in designing the extension approach. The altitude extension thus will add a new dimension of hill development by encompassing variations with altitudes in the livelihood, culture, biodiversities what we may term, as the Altitude Extension.

Key words: *Altitude Extension, blanket extension recommendations, Communication channel (AKIS)*

T2A-12

Study on resource use efficiency of selective NICRA interventions on climate resilient Agro technologies and constraints faced by beneficiary farmers in Lakhimpur district of Assam

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Abstract

The present study was conducted to analyse the economic aspects of the project, National Innovations in Climate Resilient Agriculture (NICRA) in Lakhimpur district of Assam. A total of 80 NICRA beneficiary farmers were selected randomly from five villages. The primary data were collected for the year of 2021-22. An attempt had been made in the study to identify the NICRA interventions and to analyse the resource use efficiency of farmers and constraints associated in the study area. Climate resilient interventions like change in crop variety and alternate land use system were studied. The study revealed that all the inputs of rice production under change in crop variety intervention, except manures and fertilizer for medium farmers, were found to be underutilized for rice growing farmers under NICRA project. For mushroom growers, except spawn, all the other inputs were also found to be underutilized. The farmers had the opportunity to increase the gross return by increasing the use of such production inputs. The major constraints faced by the NICRA beneficiary farmers were found to be poor economic condition of farmers, lack of assured market, higher percentage of small land holding of farmers, non-use of recommended dose of inputs ,post- harvest storage problem, high incidence of pest and disease, low access to agricultural credit and storage problem.

Key words: *Resource use efficiency, constraints, climate-resilient agro interventions, change in crop variety, alternate land use system, underutilized*

T2A-13

Integrated nutrient regimes on Sweet corn in mid altitude of Meghalaya under varied planting dates and their agro-economic evaluation

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Abstract

Sweet corn is a remunerative cultivar of maize crop known for its sweetness and beneficial nutrient content across the globe, cultivated mostly in urban and peri-urban regions of the country. To understand the preferable sowing window with the changing climate of North Eastern region of India, an experiment was taken up at the experimental farm of College of Post Graduate Studies in Agricultural Sciences, Meghalaya for two consecutive years (2021-22 and 2022-23). The field trial was conducted under a split plot experimental design. Main plot constituted of three different sowing dates, under sub-plot four different levels of nutrients application was kept and the experiment was replicated thrice. The pooled data of two years revealed that, the crop sown during third week of June month performed better over other dates of sowing in terms of growth and yield parameters. Regarding growth characteristics, there was no significant variation across the sub-plot treatments. The third week of June showed better performance in terms of output with an average cob yield of 4.8 t ha^{-1}. Similarly, sub-plot treatments gave output yield of about 4.3 t ha^{-1} of sweet corn. Significant variation in the cob production was observed over the treatment of control plots, however, no significant difference in the yield reported from farm yard manure, poultry and inorganic sources. The highest BCR percentage approximately about 1.38% was observed during the third week of June, and by 0.48% across the sub-plots. Since sweet corn pays well, farmers in North Eastern India should think about planting it for their own livelihood and for the improvement in the third week of June.

Keywords: *Farm yard manure, poultry, sowing dates, North East Region, inorganic sources of nutrients, sweet corn*

T2A-14

Adapting to Climate Change: The Promising Role of Silicate Solubilizing Bacteria in Sustainable Crop Production

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Abstract

Climate change is a serious threat to global food security through its impact on crop yields; it raises temperatures, alters precipitation patterns, and enhances both biotic and abiotic stress frequencies. In the context of this set-up, silicate solubilizing bacteria (SSB) develop into crucial collaborative players in sustainable farming since they represent biological means of promoting good soil conditions and crop resistance. This review explores the possibility of improving crop stress tolerance and nutrient uptake, thereby increasing yield and sustainability, and, in effect, mitigating the effects of climate change on agriculture by utilizing SSB. SSB solubilizes silicate minerals in soil, making silicon available to plants. The silicon itself has been recognized as playing a role in the process of stiffening the cell walls of plants, which in turn makes them less susceptible to attacks from pests, including diseases, making them stronger so they can withstand harsh conditions like wind and rain. Various studies outlined in the review include rice (*Oryza sativa*), where treatment by SSB has increased resistance against pathogens such as blast fungus (*Magnaporthe oryzae*) and improved tolerance to drought conditions. Likewise, SSB improves drought resistance and overall biomass in wheat (*Triticum aestivum*). The review also discusses how SSB interacts with other useful soil microorganisms that improve soil structure and nutrient cycling. It also touches upon the ability to be applied in large fields and persistent SSB in the

case of climate change. Utilizing SSB in agriculture is a forward-looking strategy to address climate change challenges, though variability in SSB potential and unclear growth mechanisms persist. Understanding SSB's ecological, genetic, and physiological interactions in the rhizosphere is crucial. This paper advocates for large-scale studies to validate lab results and solidify the basis for SSB-enabled climate-smart agriculture systems.

Keywords: *Biotic and Abiotic Stress, Climate Change, Climate-Smart Agriculture, Silicate Solubilizing Bacteria (SSB), Soil Health and Sustainable Agriculture*

T2A-15

Crop Residue Management Technologies' Potential to Help India Achieve Sustainable Development Goals in the Face of Changing Climate Scenarios

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Abstract

Crop residue is a dry biomass that is left behind after crops are harvested and is frequently seen as waste in the agricultural industry. Crop residue output rises as more food is cultivated to feed India's rapidly expanding population. India, an agrarian nation, generates more than 500 million tonnes of crop waste annually, primarily from areas that are farmed for wheat and rice. For a variety of reasons, crop residues are typically burned in open fields. These include the high cost of residue removal and incorporation, labour shortages, short time intervals between kharif crop harvesting and rabi crop sowing, improper residue management techniques, low nutrient values, and socioeconomic factors. According to the tenets and regulations of the bioeconomy, Crop Residue Management (CRM) provides small farmers with the opportunity to improve soil quality and overall health, reduce pollution emissions, and create items with added value from agricultural residues by putting straw into the soil. The bioeconomy's four pillars are as follows: 1) guaranteeing food and nutrition security; 2) reducing reliance on non-renewable resources and boosting the use of biomass for electricity; 3) practicing sustainable resource management; and 4) reducing greenhouse gas emissions and mitigating the effects of climate. At the same time, the Sustainable Development Goals (SDGs) comprise 17 interconnected global objectives that aim to serve as a "roadmap for realizing a more sustainable and better future for everybody". Alternatives to burning crop residues help meet SDG 3 (good health and well-being) and SDG 13 (climate action). Greenhouse gas emissions from burning agricultural residue increase by around 0.027 Gt CO_2 equivalent. Therefore, by boosting the activity of soil organisms (SDG 15—Life on land), the application of climate-smart agricultural practices and conservation agriculture practices, which incorporate crop stubble into the soil in addition to carbon sequestration (SDG 13—Climate action), can increase the soil's organic carbon content. and mitigating climate change. Straw increases the variety and metabolic activity of soil microbes, while crop residues with a high "C:N" ratio feed soil microorganisms (SDG 15). When agricultural leftovers are used as industrial raw materials or feedstock for the production of biofuel and bioenergy (SDG 7; SDG 1: Reducing poverty; SDG 2: Ensuring food and nutritional security), farmers have access to revenue and employment opportunities. Crop residue-driven cottage industries, such growing mushrooms from paddy straw & preparation of vermicompost from paddy straw, greatly improve household food and nutrition security (SDG 2) and provide employment opportunities for farmers (SDG 8), particularly women (SDG 5). Therefore, crop residues should be considered as a potential black gold which has the capacity to achieve SDGs in the Face of Changing Climate Scenarios.

Key words: *Crop residues, Climate change, Sustainable Development Goals, Food security*

T2A-16

Nanotechnology for Sustainable Crop Production

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Abstract

With the global upsurge in population and rapid urbanization, farmers across the globe are left with the daunting task of feeding more mouths every year from agricultural fields which are dwindling correspondingly. The production level of food grains as well as the declining natural resources is a subject of concern throughout the global. With natural resources getting exhausted, it is through agriculture that we can envisage a self-sustainable world. This requires the need to modernize agricultural practices with safe and effective technologies that focus on increased agricultural production while causing less harm to the environment and humans. Nanotechnology aids in the improvement of crop output in agriculture by reducing input losses and ensuring efficient nutrient and water management. These include the advancement of nano-formulations of agrochemicals as nano fertilizers for increased crop yield, crop protection and soil health as well as an effective alternative to agrochemicals. Nano silica and zeolite based nano fertilizers through mechanisms such as targeted delivery or slow/controlled release mechanisms and conditional release, could release their active ingredients in response to environmental triggers and biological demands more precisely. This would causes an increase in nutrients use efficiency, reduces soil toxicity, minimizes the potential negative effects associated with over dosage and reduces the frequency of the application. Hence, nano fertilizers could be best and suitable substitute of

chemical fertilizers in getting high potential yield and achieving sustainable agriculture especially in developing countries.

Keywords: *Nano-formulations, Agrochemicals, Sustainable Agriculture, Environmental*

T2A-17

Strategies for Efficient Resource Utilization through Intercropping System

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Abstract

Intercropping is a traditional farming system that increases crop diversity to strengthen agroecosystem functions while decreasing chemical inputs and minimizing negative environmental effects of crop production. Intercropping is currently considerable interest because of its importance in sustainable agriculture. Here, we synthesize the factors that make intercropping a sustainable means of food production by integrating biodiversity of natural ecosystems and crop diversity. To accelerate sustainable intensification of agricultural production, it is required to develop intercropping systems that are highly productive and stable under conditions with abiotic constraints (water, nutrients and weather). Intercropping can increase the farm output per unit area by more efficient utilization of resources such as land, water, nutrients and solar radiation. Legume-based intercropping increases the physical, chemical, and biological qualities of soil to re-establish its fertility. In addition to well-known yield increases, intercropping can also increase yield stability over the long term and increase systemic resistance to plant diseases, pests and other unfavorable factors (e.g., nutrient deficiencies). The efficient use of resources can save mineral fertilizer inputs, reduce environmental pollution risks and greenhouse gas emissions caused by agriculture, thus mitigating global climate change. Intercropping potentially increases above- and belowground biodiversity of various taxa at field scale, consequently it enhances ecosystem services. Complementarity and selection effects allow a better understanding the mechanisms behind enhanced ecosystem functioning. The development of mechanization is essential for largescale application of intercropping. Agroecosystem multifunctionality and soil health should be priority topics in future research on Intercropping.

Keywords: *Intercropping, Resources use efficiency, Biodiversity, Environmental pollution*

T2A-18

The Symbiosis of Arbuscular mycorrhizal fungi and plant: A perspective on the dynamic trade-off of resources and services

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Abstract

The mutualism, exploitation, and fitness of symbiotic partners in the plant-mycorrhizal interactions are revisited and meta-analysed to uncover the dynamic trade-off strategies involved in the exchange programme of resources and services. The symbiotic relation between AM species and host plant is highly context-dependent however in most of the studies, AMFs are classified as parasitic or mutualistic based on biomass loss or gain respectively by the host plant. This mere classification may exclude potential benefits of AMF in other domains besides promoting increased growth and yield of the host plant. Some AMFs are known to render survival benefits to their host plants under extreme stress conditions and other interactional benefits. From the ecological perspective, besides nutrient trade-offs via mycorrhizal uptake pathway, many of the inconspicuous exchanges of materials and services must be considered while classifying AMFs. Considering such necessity and relevance to sustainable agriculture and ecology, we proposed to classify the trade-off system into primary and secondary trade-off systems. Here, in the primary trade-off system, basic resources of plant's photosynthates and nutrients acquired by AMF, in short, the C-P trade-off is proposed and found relevantly interpreted by the biological market theory. The secondary trade-off system where provisional exchanges of resources and services are dealt with, shall underpin a guided understanding of the symbiotic interaction and identification of AM species for other attributes besides crop productivity. The mycorrhizal growth response predicted from the primary trade-off is not proportionate to the degree of mycorrhizal colonization and hence the concept of the secondary trade-off may be supported.

T2A-19

Design and development of digital weighing pan using load cells for agricultural produces

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Abstract

This Research work adopted a method for accurate weighing measurement using a microcontroller and a load cell-based weighing sensor for measuring Agricultural produces. The Aim of the project is to develop a simple and effective system for measuring the weight of Agricultural produces with a precision of up to 0.01g. The Microcontroller is used as the main processing unit to collect and analyze the sensor data and to display the results on a digital screen. The load cell-based weighing sensor is connected to the Micro controller via an amplifier circuit that provides a stable output signal. The system can accurately measure the weight and transmit the data wirelessly to a mobile device via Bluetooth, and record the measurements in real time. The system is designed to be user-friendly and customizable, with options for calibration and unit conversion. The proposed method offers an affordable, accurate measurement with monitoring and reliable solution for various applications that require weighing measurement, such as laboratory experiments, food preparation, or industrial processes to ensure quality control and processes. In this proposed research work using Microcontroller and Load Cell with a Bluetooth module is a cost-effective and reliable solution for weight measurement and monitoring for various densities of agricultural produces. It can provide accurate measurements, real-time data recording, and wireless communication, making it a valuable tool for farmers on date to date.

Keywords: *Agriculture, Microcontroller, sensor, Data Transmit, Quality Control, Bluetooth Module*

T2A-20

Myzus persicae-Brassica juncea interaction in evolutionary perspective look

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Abstract

Myzus persicae (Sulzer) is a nefarious pest of Brassicaceae family which feeds on over five hundred host plants belonging to forty different families and various chief agricultural crops. The present experiment studies on *Myzus persicae* interaction with different lines of *Brassica juncea* in the similar above and below ground environment. From the result, it was evidenced that a specific aphid dose contributed more progeny as compared, thus indicating a novel parameter for enhancing host susceptibility. It was indicated that host resistance might break down with a suitable aphid inocula and it was dependent on an initial aphid density. The specific dose of aphid was explored for evaluating 92 lines of *Brassica juncea* in the same environment. Eight aphid proliferation parameters were used to categorise *Brassica juncea* lines. The Principal component analysis resolved all *Brassica juncea* lines into two groups: more resistant lines and more susceptible lines. Out of all, four more susceptible lines and four more resistant lines were selected. The earliest and enhanced host susceptible time points of the selected lines were also identified individually to snapshot an 'evolutionary' footprint seeding at an early time point between aphid saliva and host vascular sap.

Keywords: *Myzus persicae, Brassica juncea, aphid proliferation, Principal component analysis, Vascular footprint*

T2A-21

Sustainability in Agriculture: A Case Study of India's Rice Exports to the European Union

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Abstract

The necessity for sustainable agricultural practices has become increasingly apparent, particularly in the context of India's rice exports to the European Union (EU). This paper analyses the need for sustainable agricultural practices by focusing on India's rice exports to the EU. Despite constituting only 2.4 percent of India's total exports as of 2021, rice exports have encountered challenges due to stringent maximum residue level (MRL) limits imposed by the EU. The EU's MRL regulations, which do not consider local agricultural conditions, have resulted in a significant decrease in India's rice exports following reductions in MRL limits for specific pesticides used in rice cultivation. This study examines the patterns in India's rice exports to the EU and the consequent effects of MRL restrictions on these exports. It highlights the health hazards associated with pesticide residues in rice, particularly for marginalised populations consuming rice that does not conform to export standards. The analysis emphasises the urgent need for India to transition towards organic and natural farming methods. Such a shift is crucial not only for ensuring food safety and protecting public health but also for sustaining India's competitiveness in global markets. By adopting sustainable agricultural practices, India can mitigate the adverse impacts of pesticide residues on human health and the environment while simultaneously improving the quality and marketability of its agricultural products. This paper stresses the urgency of embracing organic and natural farming as a viable solution to address the challenges posed by MRL regulations and to promote long-term sustainability in India's agricultural sector. **Keyword:** *Rice exports, Trade, MRL limits.*

T2A-22

Systematic Literature Review: Assessment of Adaptation Strategies and Vulnerabilities of Indian Farmers against Climate Change

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Abstract

Climate Change threatens the sustentation of agriculture ecosystems. Such, a challenge has not gone unnoticed and is being combated by the farmers in taking up adaptation strategies to conserve the natural entity of earth. By studying adaptation strategies of Indian farmers', the practical and effective ones for conservation and longevity of the natural ecosystem can be identified. Farmers have been speculated to be one of the most vulnerable groups to climate change risk, this study tries to assess the vulnerabilities of the farmers. With this background the objectives drawn for the study were- 1. To identify the adaptation strategies and practices taken up by Indian farmers, 2. To assess the vulnerability of Indian farmers to climate change. To achieve the stated objectives, Reporting standards for Systematic Evidence Syntheses (ROSES) method of Systematic Literature Review was employed. For searching up the reports "climate change" and "vulnerability" and "India" and "farmers" and "adaptation" and "strategies" or "practices" strings were used. A total 162 research articles were identified, from which 115 were selected after the screening. To further determine their eligibility, the title and abstract were manually read, of which 63 articles were deemed eligible. On further scrutiny of the articles only 33 were included for the final appraisal. The results of the study depicted the adaptation strategies adopted by the farmers into 6 themes- Crop Management, Soil Management, Water Management, Livestock Management, Financial Management and Livelihood Diversification. While most farmers were moderately vulnerable to climate change. Policy makers and extension functionaries can benefit from this study by focusing on adaption measures that farmers support. Also, it calls for more studies to be conducted on assessing the vulnerabilities of farmers.

Keywords: *Adaptations, climate change, farmers, India, strategies, vulnerabilities*

T2A-23

Physical Properties of Multifloral Honey produced from different Flora of Ri-bhoi District Meghalaya, India

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Abstract

Honey is one of the most important bee products of Honeybee, widely used as food, anti-inflammatory, anti-oxidant and anti-bacterial agent throughout the world. India produces different types of honey which shows specific physical properties assuring acceptable quality as prescribed by the International Honey Commission. The published reports on the physical properties of honey are in line with the present investigation of four physical properties analysed by following standard methods. Most of the physical properties viz., pH content (3.58), Ash content (0.24%), moisture content (15.3%) and the free acidity (40meq/kg) revealed a significant result compared to the market honey. Results from the present investigation clearly indicated that forage collected by honeybees from various flora available at Natural farming site of Kyrdemkulai exhibit specific physical properties and which is unique to multifloral honey.

Keyword: *Multifloral honey, Ash content, Moisture content, pH, Free acidity*

T2A-24

Agro-biodiversity and Ethnobotany in Northeast India: Conservation, Utilization, and Valuation

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Abstract

North-East India, which falls under the Indian Eastern Himalayan region and forms part of two global biodiversity hotspots, is well-known for its rich diversity of flora, fauna, cultures and traditional knowledge systems. Agriculture is the main occupation of the communities living in this region supplemented by utilization of wild useful species from the nearby forests. Presently, there has been a gradual shifting from subsistence cultivation to commercial agriculture driven by market forces and modernization, leading to transition from traditional to intensive agriculture and monoculture of cash crops. This has resulted in reduced cultivation of local crop varieties and disappearance of the associated traditional ecological knowledge (TEK). Therefore, the present study attempts to review the contribution of traditional agricultural practices to agrobiodiversity conservation and sustainable natural resource management. Relevant traditional practices such as shifting (Jhum) cultivation systems, bamboo-drip irrigation, paddy-cum-fish cultivation, traditional agroforestry systems of different Indigenous communities residing in different states of North-East India were mentioned in this review. The Northeastern region of India, comprising eight states, is a globally significant hotspot of agrobiodiversity and ethnobotanical knowledge systems. The unique status of agrobiodiversity and ethnobotany in Northeast India and

evaluates strategies for its holistic conservation, sustainable utilization and comprehensive valuation. It highlights pioneering initiatives and successful models that could inform replicable approaches for duly recognizing and revitalizing this vital biological and cultural heritage.

Theme 3; Advances in crop improvement for futuristic agriculture

T3A-1

Noncoding RNAs: A potent tools for crop improvement in Aluminium toxicity soils

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Abstract

Noncoding RNAs (ncRNAs) belong to the class of RNA molecules that cannot be translated into proteins. These are functional RNAs which perform a variety of biological functions. They regulate gene expression at the levels of transcription, RNA processing and translation. Metal toxicity could have emerged from an excess of needed concentrations of metals found naturally in the soil which has become concentrated as a result of anthropogenic activities. Heavy metals (HM) such as Pb, Cd, Hg, Fe, Al and As which do not play any beneficial role in plant growth, but have adverse effects have been recorded at very low concentrations. Al toxicity is one of the main factors restricting crop yields, especially on acidic soils with a pH value of 5.5 and below are susceptible to the effects of Al toxicity, because the combined Al will dissociate into free Al ions (mainly trivalent Al ions, Al^{3+}), the ionic form of Al is toxic to plants. The most visible effect of Al on plants is to inhibit root elongation. The root system is destroyed and the absorption of water and nutrients is restricted which ultimately leads to reduced crop yields. ncRNAs are involved in regulating HM-response processes, by further understanding the mechanisms of HM regulatory networks, which will pave the way for improving the function of crop tolerance to HMs. A great number of ncRNAs have been identified in a variety of plants that are involved in a variety of HM-stress responses. However, ncRNAs provide methods for the study of the molecular mechanism of plant resistance to heavy metal stress as well as ideas for improving the stress resistance of crops through genetic manipulation of small molecules.

Keywords: *Acidic soils, heavy metal stress, ncRNAs*.

T3A-2

Genetic Evaluation of Chickpea (*Cicer arietinum* L.) for Suitability in Mechanized Harvesting

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Abstract

Chickpea (*Cicer arietinum* L.) is an important pulse crop cultivated across the globe for its nutritious seeds. Traditionally, chickpea harvesting has been a labor-intensive process, often relying on manual methods. However, with the increasing scarcity of agricultural labor and the need for enhanced efficiency, there is a growing demand for the development of chickpea varieties suitable for mechanized harvesting. Nevertheless, mechanizing chickpea cultivation significantly lags behind cereal crops, hindering its global expansion. India, with an annual chickpea production of 9.94 million tonnes, is committed to enhancing operational efficiency through the cultivation of chickpea varieties conducive to mechanical harvesting. This study was conducted for assessment of 43 different genotypes, including 2 check varieties, with respect to mechanical harvesting attributes, yield and yield components. D square, PCA and cluster analysis were performed for divergence studies. Variability analyses revealed significant diversity, underscored by high heritability in key traits such as first pod height, pods per plant, and seed index, indicative of prevailing additive gene action. Positive correlation among these traits observed at both phenotypic and genotypic levels underscored role of these traits in augmenting seed yield. Path analysis revealed positive influence of biological yield, harvest index, and first pod height on seed yield per plant. Noteworthy, attributes including first pod height under actual condition, seed index, days to 50% flowering, and harvest index made substantial contributions to genetic divergence. Cluster analysis delineated promising genotypes (e.g., ICC 6811, ICC 13816) for hybridization, distinguished by their notable inter-cluster distances. Principal component analysis elucidated six key components, with the initial two components accounting for a significant 40.7% of the total variance. Remarkable genotypes conducive to mechanical harvesting included ICC 12492, ICC 11627, ICC 440, ICC 2065, and ICC 1164, characterized by their distinctive plant growth habit, height, first pod height, pods per plant, and seed yield. We gained insights for future hybridisation programs, emphasising traits crucial for mechanised chickpea cultivation.

Keywords: *Chickpea, automated harvesting, genetic variance, crossbreeding*

T3A-3

Metabolic engineering of secondary metabolites in plants

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Abstract

Plants produce a wide range of secondary metabolites that play vital roles for their primary functions such as growth, defence, adaptations or reproduction. The importance of plant natural products to both plants and animals coupled with advances in technological approaches has resulted in being able to engineer plants for value-added crops, increased resistance/defence, enhanced coloration, and more. Since ages these plant SMs are being used to safeguard as well as facilitate human health and living in a variety of ways by being therapeutic, nutraceutical, taste influencer, antioxidant, aromatic, and even colour producing in nature. Chemical synthesis of these molecules is considered difficult and expensive due to their structural complexity. Therefore, at this juncture, biotechnological intervention offers suitable alternative strategies and methods to produce these phytochemicals of therapeutic and commercial importance (Bagal et al., 2023). After observation on biosynthetic pathways and regulatory factors, it has become possible to metabolically engineer new potentials in plants as well as successfully engineer whole pathways (Birchfield & McIntosh, 2020). Some of the plant secondary metabolites are beneficial to mankind as nutraceuticals and pharmaceuticals. Metabolic pathways and their regulatory mechanism are crucial for targeting metabolite engineering (Devi et al., 2023). Different biotechnological approaches have been introduced in metabolic engineering like gene overexpression, gene silencing, precursor supply, organelle targeting, transcription factor manipulation etc. to increase the production of secondary metabolites in plants.

Keywords: *Secondary metabolites, Biosynthetic pathways, Metabolite engineering, Gene overexpression*

T3A-4

Targeted Genome Editing for Crop Improvement in Post Genome-Sequencing Era

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Abstract

Crop improvement is essentially required to provide food security and better nutrition globally for human beings. Plant breeders are utilizing both conventional and modern breeding techniques to increase crop production and quality. Though in the genome-sequencing era, marker-assisted selection-based breeding reduced timespan required for developing new plant variety from ~ 25 to ~ 7 years. But plant breeders are still looking for appropriate molecular method to quickly and precisely improve specific traits in plants. Recently discovered genome editing methods have revolutionized available technology for crop improvements. Genome editing is a tool of genetic engineering, which using engineered nucleases edits DNA of an organism. In editing, DNA is inserted, deleted, or replaced in the genome using engineered or designer nucleases. These nucleases create site-specific double-strand breaks (DSBs) at precise locations in the genome. The induced DSBs are repaired through more frequent nonhomologous end joining or less frequent homologous recombination, resulting in targeted mutations. The most common used engineered nucleases include meganucleases, zinc-finger nucleases, transcription activator-like effector nucleases, and clustered regulatory interspaced short palindromic repeats/CRISPR-associated 9 (CRISPR/Cas9). Targeted genome editing is the emerging technology that has wide applications in targeted gene mutation, creating chromosome rearrangement, gene function, SNP determination, and evolutionary studies in different organisms including plants, animals, and insects. Therefore, genome editing technology is a very prevailing technique that can be used toward fulfilling the demand of increasing food supply. Additionally, it is also a very effective technique in improving the nutritional value of crops, producing pest-resistant, abiotic stress-resistant, herbicide-resistant, and disease-free crops. In this chapter, we will broadly discuss the principles of the different techniques of genome editing and their applications in crop improvements.

Keyword: *(CRISPR/Cas9), genome-sequencing, double-strand breaks (DSBs), zinc-finger nucleases*

T3A-5

CRISPR-Cas9 Techniques for Millet Improvement

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Abstract

CRISPR-Cas9 is revolutionizing millet enhancement, boosting resilience and nutritional content. Despite their significance, millets have been overlooked in genetic research. Yet, with breakthroughs like CRISPR-Cas9, targeted genetic tweaks are now possible. CRISPR-Cas9 facilitates precise gene-level analysis, particularly for stress resilience traits, fortifying crop endurance. By editing specific genes linked to climate resilience and nutrient enrichment, millet yield and nutritional quality may be enhanced. This system, consisting of single guide RNA (sgRNA) and Cas9 endonuclease, identifies and cuts target sequences, prompting DNA repair pathways. Foxtail millet, a genome editing model, showcases successful CRISPR-Cas9 applications, offering insights into trait enhancement. Furthermore, it's been utilized to breed double haploid lines, highlighting its utility in crop refinement. Expanding CRISPR-Cas9 usage to other

millet varieties could unlock their genetic potential, addressing agricultural hurdles. Precise genome editing could fortify millets against environmental shifts, addressing nutritional needs and revolutionizing agriculture for global food security.
Keywords: *CRISPR-Cas9, Millet, Genome Editing*

T3A-6

Genetic divergence and variability studies for yield and quality traits in rice (*Oryza sativa* L.) cultivars from Manipur and Assam

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Abstract

Genetic diversity and variability studies was carried out with 41 diverse cultivars of rice using Mahalanobis D^2 statistic. The genotypes were evaluated in RBD at Biswanath College of Agriculture, Assam Agricultural University, Assam with an objective to understand the nature and degree of genetic divergence among the genotypes with regard to grain yield and quality traits. Twelve distinct clusters were created from the genotypes, out of which Cluster IV was the largest, with the most genotypes (12 total), followed by cluster V (8 genotypes), cluster X (5 genotypes), clusters II and XII (4 genotypes each), cluster I (2 genotypes), and clusters III, VI, VII, VIII, IX, and XI (1 genotype each). Grain length showed the greatest contribution to divergence among all the characters under study. The results indicated that there was a considerable degree of diversity inside the cluster, with clusters X and XII displaying the largest intra-cluster distance and cluster XII exhibiting the maximum inter-cluster distance. Genotypes were chosen for a hybridization programme based on per se performances and the genetic distance between them. It is presumed that superior heterotic combinations will result from hybridization between the genotypes of these varied clusters. There was a significant variation in the GCV and PCV values for the total number of grains per panicle; number of filled grains per panicle; grain yield per plant; biological yield; harvest index; 100-grain weight; and volume expansion ratio. For the majority of the characters in the study, high heritability and high genetic advances as a percentage of mean were found, suggesting that these qualities are more transmissible and that selection may be made efficiently using these characteristics. In order to increase grain yield and quality, these traits may be taken into consideration when establishing the selection criteria.
Keywords*: Rice, cluster, diversity, D^2 statistic, variability*

T3A-7

Effect of Zinc Fertilization on Growth and Yield of Okra (*Abelmoschus esculentus* L.)

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Abstract

Okra [*Abelmoschus esculentus* (L.)Moench] commonly known as lady's finger or that, belongs to the family Malvaceae. It is widely adopted and popular vegetable in Indian kitchens and can be grown in summer and rainy seasons throughout India. Okra is an important vegetable grown for its tender fruits which are used as a vegetable in various ways. The field experiment was conducted during *Zaid*season of year 2021 at the research plot of Department of Agricultural Chemistry and Soil Science, Udai Pratap (Autonomous) College, Varanasi. The experiment was carried out in randomized block design (RBD) with six treatments and three replications. Treatments comprising T_1 = Control (RDF:N:P:K), T_2 = RDF+Zn @ 1 kg ha^{-1}, T_3 = RDF+Zn @ 2 kg ha^{-1}, T_4 = RDF+Zn @ 4 kg ha^{-1} , T_5 =RDF+Zn @ 6 kg ha^{-1} , T_6 =RDF+Zn @ 8 kg ha^{-1}. Recommended dose of fertilizer viz; N @ 20 kg ha^{-1}, P_2O_5 @ 10kg ha^{-1}, and K_2O @ 10kg ha^{-1} were applied as basal application. The minimum plant height was recorded in treatment T_1 and maximum with treatment T_6 (8 kg ha^{-1} of zinc) at 15, 30 and 45 days after sowing, Length of fruit also significantly and positively affected by zinc application. T_6 registered maximum length of fruit, Fruit weight increased significantly with the application of zinc at various doses. Maximum weight was produced by T_6, Fruit and stover yields were increased with the application of increasing levels of zinc. The maximum yields were recorded with the application of 8kg ha^{-1} of zinc (T_6) and Nutrients (N, P, K, and Zn) and protein content in fruit were significantly increased by all the treatments containing Zn as compared to control (without Zn). The minimum contents were recorded with T_1 and maximum with T_6.
Keywords: *Growth, Yield, Okra, Zinc*

T3A-8

Advancements in Genomic Editing: Harnessing CRISPR-Cas9 for Agricultural Transformation

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Abstract

In the face of burgeoning global food demands and environmental challenges, modern agriculture stands at a pivotal juncture, necessitating innovative solutions to enhance crop resilience, productivity, and sustainability. Genomic editing, particularly the revolutionary CRISPR-Cas9 technology, has emerged as a transformative tool with immense potential to address these pressing issues. This poster presentation delves into the profound impact of genomic editing and CRISPR-Cas9 in agricultural contexts. The presentation will begin by elucidating the underlying principles of CRISPR-Cas9 technology, highlighting its unparalleled precision, efficiency, and versatility in targeted genome modifications. Through precise genetic alterations, CRISPR-Cas9 enables the development of crop varieties endowed with desirable traits such as enhanced yield, disease resistance, and tolerance to environmental stresses. Furthermore, the poster will explore a myriad of applications of genomic editing in agriculture, encompassing crop improvement, livestock breeding, and microbiome engineering. By elucidating successful case studies and ongoing research initiatives, we will showcase the potential of genomic editing to revolutionize agricultural practices, mitigate yield losses, and foster global food security. Moreover, the ethical, regulatory, and socio-economic implications of genomic editing in agriculture will be deliberated, underscoring the importance of responsible innovation and stakeholder engagement in shaping the future trajectory of agricultural biotechnology. In conclusion, this poster presentation encapsulates the transformative potential of genomic editing and CRISPR-Cas9 in revolutionizing agriculture, paving the way for sustainable food production systems that can meet the challenges of tomorrow while safeguarding the integrity of our planet.

T3A-9

Screening of Promising Genotypes of Wheat and Management of Leaf Rust Caused by *Puccinia triticina* Kriks

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Abstract

The present investigation on study on incidence, severity and management of leaf rust of wheat was conducted at Main Experiment Station and laboratory of department of Plant Pathology, Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya (U.P.), India during *rabi* 2019-20. Survey was conducted in five districts of Eastern Utter Pradesh that showed the presence of leaf rust of wheat in the surveyed area viz., Ayodhya, Sultanpur, Amethi, Jaunpur and Varanasi. The incidence of leaf rust was found in the range between 6.83-8.37 percent being highest in Ayodhya (8.37%) followed by Sultanpur (7.52%), Jaunpur (7.48%), Amethi (7.21%), and Varanasi (6.83%). Minimum severity (5MS-30S) was recorded in Varanasi with maximum (60S-80S) in Ayodhya and s Sultanpur (30S-60S), Juanpur (20MR-40S) and Amethi (10MR-30S). Out of 150 wheat genotypes screened against leaf rust disease under artificially inoculated field conditions, six genotype/lines were found immune, 33 were traces severity of resistant, 30 genotypes were moderately susceptible (MS), and 55 were found moderately resistant and 26 genotypes were found susceptible against leaf rust. Among all the treatments, minimum disease severity (11.25%) in treatment, two foliar spray of Tilt 25 EC @ 0.1 at 15 days interval at first appearance of disease) and maximum disease severity (70.00%) was recorded in control. Maximum thousand seed weight (40.53g), maximum seed yield (26.2q/ha), % increased grain yield by (29.7%), avoidable losses (22.9%) and maximum Benefit-cost ratio (4.76) was found in treatment, two spray of Bayleton 25% WP @ 0.1% at 15 days interval.

Keywords: *Disease severity***,** *Leaf rust***,** *Managme*nt**,** *Propiconazole*

T3A-10

Advances in Crop Improvement of Rice

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Abstract

Rice (Oryza sativa) is one of the most important staple crops worldwide, serving as a primary source of nutrition for a significant portion of the global population. Over the years, extensive research efforts have been dedicated to enhancing rice production, quality, and resilience to various environmental stresses. This paper presents a comprehensive overview of recent advances in crop improvement within the realm of rice research. Firstly, it explores the revolutionary impact of genomic editing technologies, such as CRISPR-Cas9, in facilitating precise and targeted modifications of the rice genome. These advancements have enabled the development of rice varieties with improved traits such as higher yields, enhanced disease resistance, and optimized nutritional profiles. Secondly, the paper delves into the emerging field of biofortification, wherein researchers focus on enhancing the nutritional content of rice grains to address widespread

malnutrition. Through breeding programs and genetic engineering approaches, rice varieties fortified with essential vitamins and minerals are being developed to combat hidden hunger and improve public health outcomes. Moreover, the paper discusses the integration of precision agriculture techniques, including data analytics, remote sensing, and IoT sensors, in rice farming practices. These technologies enable farmers to monitor and manage crops more effectively, optimizing resource use, reducing environmental impact, and enhancing overall productivity. Furthermore, the paper highlights advancements in breeding programs aimed at enhancing rice resilience to climate change-related challenges, such as drought, salinity, and extreme temperatures. By selecting for traits associated with stress tolerance and utilizing innovative breeding strategies, researchers are developing rice varieties capable of thriving in increasingly unpredictable environments. Additionally, the paper examines the role of sustainable farming practices, such as organic farming, conservation agriculture, and agroecology, in promoting long-term agricultural sustainability and resilience. These approaches emphasize soil health, biodiversity conservation, and ecosystem services, contributing to more resilient and environmentally-friendly rice production systems. In conclusion, the paper underscores the pivotal role of ongoing research and technological innovation in driving progress in rice crop improvement. By harnessing the latest advancements in genomics, biotechnology, and agronomy, researchers are poised to develop rice varieties that are more productive, nutritious, and resilient, thus contributing to global food security and sustainability goals.

T3A-11

Physiological and biochemical characterization of elite sorghum genotype under different regimes of water stress

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Abstract

Sorghum is an economically important and staple food crop for over half a billion people in developing countries, mostly in arid and semi-arid regions where drought stress is a major limiting factor. Although sorghum is generally considered tolerant, however, understanding both the effects and mechanism of drought stress and plant response is indispensable for improving the drought tolerance of the crop. The present analysis was conducted in the Crop Improvement Division, ICAR-IGFRI, Jhansi, India to analyze the effect of drought stress on morphological, physiological, and biochemical attributes of sorghum genotypes. The first experiment was a short-term experiment conducted to screen sorghum 22 genotypes line at the early growth stage under different concentrations of PEG 5%, and PEG 10%, with control (C). The 2nd experiment includes 60% FC (moderate drought; D1) and 40 % FC (high drought; D2) with control. In this experiment, 12 elite sorghum genotypes were used for physiological, biochemical, and anatomical characterization. In the present study seed germination, seedling length, and seedling Vigor were measured and found to be affected under different concentrations of PEG. Whereas, the pot experiment showed that the water stress tolerance germplasms maintain high levels of chlorophyll content, relative water content, membrane stability, MDA, APX, POD, stomatal density, and vein density under stress environments. Conclusively, this report compiles the effect of drought stress on seedling establishment, and the physiological, biochemical, and anatomical behaviour of fodder sorghum crop and the identified tolerant line IG-02-382 could be used for further drought stress breeding programs.

Keyword: *Drought Stress, Proline, Antioxidant defense, Relative water Content, stomatal movement*

T3A-12

Evaluation of efficacy of isolates of *Trichoderma asperellum* against soil borne plant pathogens and plant growth promotion

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Abstract

Trichoderma is a biocontrol fungus widely distributed worldwide. It has a huge application value and potential in the field of biological control of plant diseases and can promote plant growth, improve the solubility of nutrients in the soil, and improve plant rhizosphere microecology. An investigation was carried out to evaluate the isolates of *Trichoderma asperellum* against soil borne plant pathogens viz., *Rhizoctonia solani, Fusarium oxysporum, Sclerotium rolfsi and Sclerotinia sclerotiorum,* and plant growth promotion of wheat, cabbage, mustard and chilli under *invitro* conditions. Out of three isolates NI resulted highest inhibition of (72.96%, 59.21%, 54.82% and 56.81%) against *Rhizoctonia solani, Fusarium oxysporum, Sclerotium rolfsi and Sclerotinia sclerotiorum.* And followed by colchicine treated mutant MU with 65.15%, 46.07%, 47.34% and 50.11% inhibition against *Rhizoctonia solani, Fusarium oxysporum, Sclerotium rolfsi and Sclerotinia sclerotiorum*. All the three isolates of *T. asperellum* showed significantly higher plant growth promotion activity when used as seed treating agents in all the crops compared to control and were statistically at par with each other. However, in cabbage and wheat, *T. asperellum* isolates did not recorded any difference with respect to germination percentage of cabbage and vigour index of wheat.

Keywords: *Trichoderma asperellum, wheat, chilli, mustard, cabbage*

T3A-13

Improvement of gladiolus (*Gladiolus species*) through in Vitro Culture and Advanced Biotechnology

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Abstract

Gladiolus, commonly known as Queen of bulbous flower, is an important cut flower used for its beautiful spikes. With more than 30,000 different cultivars being grown, it ranks 8th among cut flowers. However, gladiolus is propagated by corms traditionally which hastens the multiplication and commercialization of the crop. With the advancement in modern biotechnology and tissue culture, large scale proliferation has been achieved. The important growth and development parameters required for in vitro gladiolus and cormel development have been highlighted in this current review. Various techniques such as in vitro mutagenesis, selection of pest resistance, in vitro identification and selection of pest resistance to develop virus-free virus germplasm, cryopreservation, identifying virus diseases by RT-PCR, somaclonal variation, protoplast and somatic hybridization are being given importance in crop improvement. The application of molecular markers is being discussed by several researches globally for the clonal stability analysis, genetic diversity analysis etc. This will aim to give insight into the comprehensive review for invitro propagation of gladiolus and highlight the advancing tissue culture as well as biotechnological tools in the crop improvement of gladiolus crop.

Keywords: *biotechnology, bulbous, improvement, highlight*

T3A-14

Accelerated Growth: Unveiling the power of speed breeding in diverse crops

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Abstract

To feed the ever-growing population, the improvement in genetic gains to increase the yield is very essential. The breeder's equation implicates that the improvement of additive genetic variation within the population, selection intensity and selection accuracy while decreasing the generation time can enhance the genetic gain. The Speed breeding protocol comes to our aid in mitigating such limitations of generation time and seasons where effective management of the environmental factors such as extended photoperiod, light intensity, vernalization protocol for winter crops like wheat and barley, day and night temperatures and early harvest of premature seeds in long-day crops is done to advance multiple generations per year. SB protocols have been developed to advance four generations of canola and six generations of spring and durum wheat, barley, peas and chickpeas compared to two to three generations possible in a glasshouse. SB also allows the crossing and inbreeding which usually takes about eight to twelve generations to be completed in two years rather than six to seven years in field conditions. The advanced and sophisticated protocols such as gene editing, phenotyping and genotyping accelerating crop improvement can be integrated along with the SB. SB has been effectively used and applied in a wide range of crops including cereals, pulses and canola crops. With an advantage of application to wide range if crops, lower manpower requirement than the conventional breeding methods, SB stands as the highly efficient, potent and practical choice for varietal development in large populated crops. Attributes such as high protein content, disease resistance, salt tolerance and drought tolerance have been successfully achieved in cultivar development of crops like cereals, oilseed and vegetables. Overall, speed breeding stands out as a transformative and promising approach for accelerating crop improvement, enhancing genetic diversity and ensuring sustainable food production in the 21st century.

Keywords: *speed breeding, genetic gain, controlled environment, shuttle breeding, genomic selection*

T3A-15

Maximizing Crop Yield and Resource Efficiency: Integrating Vertical Farming Technologies with Breeding Programs

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Abstract

Vertical farming has become a viable way to improve sustainable food production in the face of climate change and rising food demand. This approach allows for the cultivation of crops indoors in controlled environments, addressing the limitations of traditional agriculture. Vertical farming focuses on high-return, short-rotation crops with traits optimized for indoor cultivation, such as rapid growth and performance in low-light conditions. Furthermore, the integration of biotechnological tools like CRISPR-Cas9 and Marker Assisted Technology (MAS) enables precise modifications to the plant genome, facilitating the selection of desirable genotypes. This review explores the potential synergies between vertical farming technologies and breeding programs aimed at developing crops tailored for indoor cultivation. By combining these approaches, it becomes possible to enhance crop yield and resource efficiency while addressing global food security and sustainability goals. **Keywords:** *Vertical farming, CRISPR-Cas9, Marker Assisted Technology (MAS)*

T3A-16

Advances in Maize through CRISPR- Cas technology for crop improvement and creation of novel Maize germplasm

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Abstract

Maize (*Zea mays L.*), a vital global food crop, thrives as a C4 plant with high yield potential. Breeding programs prioritize traits like drought tolerance and disease resistance for climate resilience. Creating elite varieties ensures sustainable agriculture, vital for feeding the expanding population amidst changing environmental conditions. Recent achievements in genomics, proteomics, and metabolomics have provided an unprecedented opportunity to make better. CRISPR-Cas mediated genome-editing technology (clustered regularly interspaced short palindromic repeats (CRISPR) - Cas (CRISPR-associated)) has emerged as an effective and powerful tool for plant science and crop improvement, and is likely to accelerate crop breeding in ways dissimilar to crossbreeding and transgenic technologies. We summarize the current applications and prospects of CRISPR-Cas technology in maize gene function studies and the generation of new germplasm for increased yield, improved quality and enhanced stress resistance, as well as male sterile lines, haploid inducers, and specialty corns. The CRISPR-Cas technology can overcome the limitations of conventional breeding due to the lack of available genetic resources and negative genetic linkage drag, and enables researchers to quickly and precisely modify target genes related to various traits in specific varieties, which has shown unique advantages in accelerating breeding process by generating new germplasms with more flexibility. Owing to its high efficiency, simple operation and low cost, high accuracy, the CRISPR-Cas technology has rapidly shown promising potential in plant functional genomics studies and the genetic improvement of crops such as rice, wheat, soybean and maize. CRISPR technology is capable of enhancing tolerance against biotic and abiotic stresses in cereal crops. CRISPR-Cas based targeted mutagenesis through base editing and prime editing to develop resilient cereal crop plants, possibly providing new dimensions in the field of cereal crop genome editing. In maize, a series of new germplasms have been generated using the CRISPR-Cas technology.

Keywords: *Maize, CRISPR-Cas, Genomics, Proteomics, Metabolomics, Germplasm*

T3A-17

Comparative analysis of growth and yield parameters of pea crop in acid soil under different bioinputs combinations

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Abstract

Peas (*Pisum sativum* L.) a legume crop, have potential to play an important role in natural farming systems. They fix atmospheric nitrogen, which improves soil fertility and reduces the need for external nitrogen inputs. *Beejamrutha, jeevamrutha*, organic manure, crop residue and biofertilizer are considered as bioinputs in natural farming that can be used to improve nutrient availability and support sustainable agricultural systems. Biofertilizers are the viable microbes colonizing the rhizosphere or interior plant parts. These microbes are not actually the source of nutrients however, support the plants in accessing the essential nutrients present in the root area of plant. So, this study assessed the effect of different combinations of bioinputs on growth and yield of pea crops in acid soils. Two sets of pot experiments (each set 36 nos.; one set for destructive sampling for root parameters and other set for plant harvest parameters) to accommodate different treatments combinations (bionput combinations: M1: OM, M2: M1+CR, M3: M2+JM, M4: M2+JM and seed treatments S1: Control, S2: *Beejamrutha*, S3: Biofertilizer) were arranged during *Rabi* season of 2023-24. For plant growth parameters, M2S1 treatment (59.8 cm) showed highest plant height among all other treatments. M3S3 treatment produced higher pod numbers (14 nos.) than others, whereas the average number of seeds per pod was higher in treatment M1S3 (7 nos.). Fresh and dry weight of plant and pod was found to be higher in treatment M4S3 (20.17 g) and M2S3 (4.9 g), respectively. For root parameters, M4S3 treatment (52016.645 cm^2), (5633.07 cm), (35263.2 cm^3), (65) recorded highest surface area, length of root, volume of root and root nodules among others. In conclusion, the growth and yield of pea crop can be enhanced through different bioinput combinations of soil treatments and effectively with the seed treatment with biofertilizer.

Keywords: *Natural farming, Beejamrutha, Jeevamrutha, Biofertilizer, Crop residue*

T3A-18

Survey and management of Alternaria blight of *Sesamum indicum* L.

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Abstract

Sesame is a herbaceous plant which grown annually. It belongs to the family Pedaliaceae and order Tubiflorae, which is cultivated for its edible seeds and oil. It is also known as gingelly, til,and benne seed, and is often referred to as the "Queen of Oilseeds" due to its high resistance to rancidity and oxidation. Sesame suffers from a number of diseases, among all Alternaria blight or leaf spot of sesame caused by *Alternaria sesami* is one of the most destructive and widespread diseases that cause significant yield losses. Alternaria blight can be managed by integrated approaches that include cultural practices, biological, botanicals, varietal resistance and chemical control. The efficacy of botanicals and fungicides were tested for management of Alternaria blight of sesame in field conditions. Eight treatments were undertaken in the study in which the disease first appeared in the untreated plot (33 DAS) and lately in the fungicides-treated plots (38 DAS). All the treatments were more or less effective and they exhibited a reduction in disease. After three sprays, maximum disease control was recorded in the plot treated with the Tabuconazole 50%+Trifloxystrobin 25% WG (56.92%), followed by the plot treated with the Thifluzamide 15%+Difenoconazole 20% (54.88%), Propiconazole (48.72%), Jivamrit (40.46%), garlic bulb extract @ 10% (36.42%%), Onion bulb extract @ 10% (39.49%), varietal mixtures (32.82%) compared to the untreated check. A similar pattern was shown at 45, 60 and 75 DAS planted crops. Overall, our findings suggested that integration of all the techniques (chemical, botanical and varietal mixture) would become an effective strategy for the management of plant disease at an optimum level.

T3A-19

Speed Breeding: A powerful tool to accelerated crop improvement

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Abstract

The growing human population and a rapidly changing climate have raised significant concern for global food security. The rate at which current crop improvement programme are progressing is essentially inadequate to meet the food demand, attributed partly to the long generation times of crop plants. Hence to cope up with these problems, it is facilitated to produce multiple plant generation that can be alleviated by "Speed Breeding" with the use of extended photoperiod and controlled environment conditions to accelerated plant growth and shorten generation. This approach facilitates the rapid development of genetically superior crops with desirable traits, such as increasing yield and enhanced disease resistance by adjusting temperature, light duration and intensity. Speed breeding can be used to achieve up to six generations per year for spring wheat (*Triticum aestivum*), durum wheat (*T. durum*), barley (*Hordeum vulgare*), chickpea (*Cicer arietinum*) and pea (*Pisum sativum*), and four generations for canola (*Brassica napus*), instead of 2–3 under normal glasshouse conditions. Integrating speed breeding with other modern crop breeding technologies, including high-throughput genotyping, genome editing and genomic selection, accelerating the rate of crop improvement.

Keywords: *Speed breeding, temperature, light duration and intensity*

T3A-20

Response of foxtail millet (*Setaria italica* L.) varieties to crop establishment techniques and nutrient sources

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Abstract

Foxtail millet is an important crop known for its adaptability to diverse environmental conditions and nutritional value. It is a resilient and versatile crop that holds immense promise for food security and agricultural sustainability, especially in regions facing challenges posed by climate change and resource constraints. The potential yield of foxtail millet is not yet achieved due to inadequate application of fertilizers, use of low yielding local varieties and lack of good management practices. Due to less cattle population in Meghalaya region, it is difficult to manage entire nutrient requirement of the crops by organic sources due to limited availability of raw material. So, there is a huge potential for natural farming in this region because preparation of nutrient sources (jeevamrutha & beejamrutha) require very less quantity of cow dung and cow urine. Moreover, in most of the crops, it is experimentally proved that yield is more in transplanted crop. Considering these points the field experiment was conducted at experimental farm of College of Post Graduate Studies in Agricultural Sciences, Umiam, Meghalaya during *kharif*, 2023 to study the response foxtail millet (*Setaria italica* L.) varieties to crop establishment techniques and nutrient sources. The study comprised of two method of establishment (line sowing, transplanting), two varieties (SiA 3156, Rajendra Kauni 1) and four nutrient treatments (Control, RDF @40:20:20, FYM @5 tha^{-1}, Beejamrutha+jeevamrutha) laid in randomized block design with factorial concept and replicated thrice. The results revealed that plant height, dry matter accumulation, test weight and grain yield were found

at their best with application of 100% recommended dose of fertilizer. Among different nutrient treatment seed/seedling treatment with beejamrutha + soil application of jeevamrutha resulted in highest post harvest available nitrogen, phosphorus and potassium. Among different establishment method, tillering ability and yield was found to be highest in transplanted foxtail millet as compared to line sowing method.

Keywords: *Foxtail, RDF, FYM, Beejamrutha, Jeevamrutha*

T3A-21

Aratak: Prospects as a blend of black tea

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Abstract

Micromelum integerrimium, locally known to the Garos as Aratak is a nutritionally rich plant with use as a traditional medicine for various ailments. However, it is not widely consumed due to its bitter taste. Therefore, value addition of the fruit is required so that it reaches maximum people. For that, we used tea as a medium and we tried blending the tea with the fruit. Firstly, the fruit was dehydrated in the traditional Garo way. Then standardization of the tea blend was done by mixing the dehydrated fruit with black tea in various proportions (50:50, 60:40,70:30, 80:20,90:10). One teaspoon of tea blend was taken in a tea ball and infused in boiling water for 2 minutes. Sensory evaluation with 25 panelists using the 9-point hedonic scale was done to select the best ratio. 50:50 ratio was observed to be the best ratio. It gave the tea a distinct flavour and reduced the bitterness of the fruit. Thus, with the help of tea and reduced bitterness its goodness will reach many people thereby helping them fight various remedies naturally without the side-effects of allopathic medicines.

Keywords: *Aratak, tea, sensory evaluation, hedonic scale, panellists*

T3A-22

Exploration of Salicylic Acid induced resistance against tomato fruit borer, *Helicoverpa armigera* (Hübner)

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Abstract

An experiment was conducted during 2022-2023 at the Insectary of Department of Entomology, Assam Agricultural University, Jorhat to evaluate the effects of exogenous application of salicylic acid (SA) as a resistance inducer on tomato against fruit borer, *Helicoverpa armigera*. The study was carried out under two sets (set A and set B) with five treatments and four replication *viz*., T_1 (SA @ 25 ppm), T_2 (SA @ 50 ppm), T_3 (SA @ 75 ppm), T_4 (SA @ 100 ppm) and T_5 (control). In order to maintain the adequate population of fourth instar larvae and achieve synchronized maturity of larvae, rearing of *H. armigera* larvae was done on both artificial and natural diets. Morphometrics study on the developmental stages of *H. armigera* was also recorded. Spraying was done once in set A at 40 days after transplanting (DAT) and two sprayings were done in set B at 40 and 80 DAT. Among all the treatments the highest reduction in per cent fruit infestation was recorded in set B in T_4 (6.54±1.33%) followed by T_3 (7.42±1.27%) whereas lowest was observed in T_5 (14.39±2.73%). Highest survivability (100%) of larvae was observed in T_5 (control). There was no infestation on foliage feeding. It was further revealed that in case of plant growth parameters highest plant height, number of branches, chlorophyll content and Relative leaf water content were recorded in set B as compared to set A. Results pertinent to yield parameters also revealed that the highest mean weight of each fruit (10.35±0.13 g) and the overall yield (212.17±13.85 g) was recorded in set B when compared to set A. The finding of present investigation holds a good promise in tomato fruit borer management with increased yield and production by inducing resistance.

Keywords: *Exogenous, tomato fruit borer, H. armigera, salicylic acid, infestation*

T3A-23

CRISPR-Based Genome Editing: Advancements and Opportunities for Rice Improvement

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Abstract

Rice(Oryza sativa) is one of the most important staple food of our country. In north eastern states of our country it is the most prominent cereal grown and consumed. To increase the potentiality of crop production for future food security, new technologies are required, including genome editing technology which overcomes the challenges of conventional breeding such as biotic/abiotic stress, undulating and fragmented land, and lack of wide scale technological intervention. Genome editing involves the usage of site specific nucleus SSNs to modify specific gene at desired location. In rice the different tools for editing underlies- TALENS (transcriptional activator like effector nucleases), CRISPR-CAS9 (clustered regularly interspaced short palindromic repeats associated endonuclease Cas-9), CRISPR-CF1, CRISPR based base editing technology. CRISPR/Cpf1 system has some important advantages over CRISPR/Cas9 which makes it more advance and efficient genome editing tool such as high cleavage efficiency. The Cpf1 also exhibit dual enzymatic activity acting as RNase as well as nuclease. CRISPR/Cas9- based base editor

technology is the latest and most advanced approach which enables direct and irreversible conversion of one target base into another without the requirement of a DSB or donor template. Some achievements are Rice yield has been improved by knocking out genes that are known to be negative regulators of grain size and number and grain weight. The CRISPR/Cas9 technology has been used to create high amylose rice. TALEN for conferring resistance against bacterial blight. Thus it plays important role in the field of genome editing highlighting major challenges and future implications of these tools in rice improvement.

Keywords: *Base editors, crop improvement, CRISPR/Cas9, CRISPR/Cpf1, genome editing, rice*

T3A-24

Breeding for drought tolerance in rice (*Oryza sativa*): Unfolding potential strategies for climate resilience

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Abstract

Rice is the basic and most important cereal crop of India. Its production is being affected by different factors and one of them playing important role is drought which has the ability to cause significant economic loss. It is becoming an important threat as the global climate is changing which in turn increasing areas prone to drought. Additionally, as the population in India is growing rapidly, there is an increasing demand for food supply. So there is urgent need for genetic development of rice varieties for drought tolerance suitable for different regions to meet the growing demand for food. Conventional methods for variety improvement will take much more time as compared to molecular breeding approaches, which provide a more rapid and specific way to develop drought tolerant varieties. To meet the needs of the current situation, more emphasis should be given on different advanced methods now and in the future. Studying different Quantitative Trait Loci (QTLs) and microRNAs (miRNAs) can provide better understanding to the mechanism underlying drought tolerance in rice. QTLs for different traits related to drought tolerance can help in screening of plants. Marker-assisted selection, using markers such as Simple Sequence Repeat (SSR) markers linked to specific QTLs, can be used for more efficient identification and screening of drought resistant varieties. So there is a huge possibility of success in future for genetic improvement of crops using different advanced approaches which will ultimately contribute to food security and agricultural sustainability.

Keywords: *Rice, drought, QTL, miRNA, SSR*

T3A-25

Management of Mungbean yellow mosaic virus under natural farming system

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Abstract

Mungbean yellow mosaic disease (MYMD), caused by the Mungbean *yellow mosaic virus* (MYMV), is one of the most important diseases infecting grain legumes, especially greengram. The virus belongs to the genus Begomovirus of the family *Geminiviridae* and is transmitted either by grafting or vector whitefly (*Bamisia tabaci*) in a persistent manner. MYMD is the most limiting factor in greengram production, and the economic losses due to this virus range from 85% to 100%. This disease was reported in India for the first time in 1955 from the experimental field of IARI, New Delhi, by Nariani, and since then, rigorous research efforts have been made to manage the disease by controlling the vector and developing varieties possessing resistance against MYMV. However, the injudicious use of chemical pesticides to control the vector has had detrimental effects on the ecosystem. Hence, many investigations have been carried out to evaluate the potential of antiviral compounds like salicylic acid and chitosan, botanicals like neem leaf extract and *Boerhaavia diffusa* root extract, and different formulations of biocontrol agents like *Beauveria bassiana* and *Metarhizium anisopliae* to manage the disease naturally. When tested against a variety of viral diseases, compounds like salicylic acid, chitosan, and *Boerhaavia diffusa* were shown to induce different defense responses in the host by producing reactive oxygen species (ROS), PR proteins, lignification, and other cell wall structural proteins during the plant-pathogen interaction. Out of the various botanicals tested for the natural control of whitely, Azadirachtin, a tetranortriterpenoid limonoid present in neem, has proved to be the most effective by producing an antifeedant effect on insects. Entomopathogenic fungi like *B. bassiana* and *M. anisopliae* produce cuticle-degrading extracellular enzymes like chitinase, lipase, and protease, which act on whitefly nymphs and cause their degradation.

T3A-26

A review of aluminium toxicity in morphological & physiological characterization in rice *(Oryza Sativa L.*)

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Abstract

Rice (*Oryza sativa L*) is one of the main staple foods of almost the world population and people are realizing its significance as a dietary role. Rice is one of the main staple foods of 50% of the world's population. Aluminium (Al)

toxicity is affecting rice growth in acidic soils. The production of rice needs to be enhanced on acidic soil where its growth is lower than in normal lands (Tao et al., 2018; Nezames et al., 2018). Heavy metal toxicity is a major problem for crop growth globally (Aamer et al., 2018). Al is the third most abundant metal in the earth's crust after oxygen and silicon. Al solubilizes into most phytotoxic forms such as Alcl3+ when soil pH drops below 5 About 40-50% of the world's arable lands are acidic leading to Al Phyto-toxicity (Von Uexkull and Murter, 1995; Panda et al., 2009). Al is a serious growth limiting factor in rice crops grown in acidic soils (Alvim et al., 2012; Pandey et al., 2013). Root growth inhibition is the main symptom of Al toxicity and it leads a typical morphological marker to assess the level of Al tolerance in crops (Chandran et al., 2008). This symptom is caused by the damaging of root apex by Al which leads to the decline in grain quality and ultimately affects rice production (Li et al., 2013). Root growth inhibition, damage of root apex, and inhibition of nutrient uptake are the symptoms that appeared within minutes after being treated with Al toxicity. Rice is more tolerant to Al toxicity under hydroponic conditions and it is two to five folds more tolerant than other cereals (Maron et al., 2008). Al and other metals are usually present in paddy soils at very low concentrations, but excessive use of some fertilizers increases acidity which enhances the concentration of phytotoxic ions (Bidhan and Bhadra, 2014; Awasthi et al., 2017). About 100 years ago, it was first reported that soluble Al is toxic for crop growth when its concentration rises in acidic soils and it results in inhibition of root growth (Kopittke et al., 2016). Al becomes more toxic when the pH of the spoils falls below 5 and easily taken by roots therefore inhibiting root growth of rice (Tanaka and Navasero, 1966; Panda et al.,)

Keywords: *Aluminium, phytotoxic, tolerance, acidic soils*

T3A-27

Role of *Myzus persicae* herbivore mediated vascular microbiota in host resistance

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Abstract

The plant-aphid interaction was co-evolved as well as co-existed more than 400 million years ago (Price et al., 2011). The total aphid species were documented › 4300 and nearly 250 aphid species are identified as agricultural 'pests' (Blackman and Eastop, 2000). *Lipaphis erysimi,* the mustard aphid alone causes up to 91% yield loss of important oil crop mustard. The green peach aphid (GPA), *Myzus persicae* (Su¨lzer) (Hemiptera: Aphididae) has an exceptionally wide host range covering more than 50 families of plants over 400 plant species. *Myzus persicae* is also an excellent vector of over 100 plant viruses (Blackman and Eastop, 2000). Therefore, it is a global concern on the control of GPA proliferation. Aphid population was controlled with chemical, biological, cultural, bio-formulation, resistance breeding and agronomic practice. The acquired resistance to insecticides poses a great concern to the farming community. Aphids are exclusively phloem feeders that tap the nutrient enriched sieve element (SE) sap having high C:N ratio. Aphids reproduce clonally and give live young birth. An aphid's embryonic development begins before its mother's birth. Therefore, *Myzus persicae* can establish a colony on foliage within a very short period. Therefore, the relationship between plant and aphid interaction should be studied from a novel perspective to uncover molecular relationships for formulating a novel way of aphid control strategy. Several reports solidified the idea that vascular microbiota tire is a novel parameter to evaluate the host resistance (Mondal *et al*., 2021; Mallick & Mondal, 2022; Mondal, 2023; Unpublished data). In the extreme susceptible time point, vascular microbiota titre was significantly higher and assumed that aphid feeding injected an initial microbiota inoculum into sucrose enriched sap. Similarly, the anti-bacterial vascular metabolite concentration was slower at the extreme host susceptibility. Thus, plant-aphid interaction uncovered two additional components like microbiota, and anti-bacterial metabolites. Therefore, a relevant study for uncovering the identity of microbiota for their evolutionary conservation within aphids.

Keywords: *Bio-formulation, Resistance and susceptible Breeding, Phloem feeders, vascular microbiota, Anti-bacterial vascular metabolite*

T3A-28

Chilli leaf curl virus infection leads to an up-regulation of transcript level of Argonautes in chilli

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Abstract

RNA silencing, facilitated by small interfering RNAs (siRNAs) and microRNAs (miRNAs), serves as a pivotal defense mechanism in plants against invasive nucleic acids. Central to this process are Argonaute (AGO) proteins, pivotal players in antiviral defenses. While the role of AGO1 in combatting RNA viruses is well-documented, its significance in DNA virus infections remains underexplored. This study delves into the expression patterns of AGO1 and AGO1b genes upon infection with Chilli leaf curl virus (ChiLCV), a DNA virus, causing leaf curl disease in chilli, across different days post virus inoculation. Through semiquantitative PCR and quantitative PCR analyses, we observed the expression of AGO1a transcripts showed a notable increase, reaching up to 1.58-fold at 10 dpi and 4.12-fold at 25 dpi, compared to non-inoculated healthy plants. Similarly, AGO1b mRNA exhibited elevated expression levels in response to ChiLCV

infection, with a 1.75-fold increase at 10 dpi and a 1.93-fold increase at 25 dpi. This upregulation of both AGOs likely corresponds to the augmented presence of Argonaut proteins in the host, prompting the plant to bolster its gene silencing mechanism and thereby restrict the invading virus. These findings elucidate the involvement of AGO1 proteins in the plant's defense against DNA viruses, broadening our comprehension of the RNA silencing pathway's role in antiviral responses. By understanding the modulation of AGO proteins and their associated miRNAs, this study lays the groundwork for the development of targeted interventions aimed at mitigating the impact of DNA viruses on crop health.

T3A-29

AMMI and GGE biplot analysis for identification of stable Mungbean genotypes for seed yield per plant under acidic soils of NEHR

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Abstract

Grain yield is a complicated quantitative character with strong environmental interaction; developing varieties or choosing parental materials for breeding programmes can be accomplished by selecting genotypes based only on how well they perform in a particular environment. Genotype × environment interaction (G × E) is a major barrier for crop to attain the full genetic advantages. The North East Hill (formerly known as NEH) region of India has greater potential of pulses production. Still, the development rate is slow because of sloppy terrains, soil acidity, aluminium toxicity. Mungbean, a short-duration pulse crop, has the potential to significantly contribute to the NEH region's security of livelihood, greater and faster revenue. Thirty-two greengram genotypes were tested under 3 locations for five seasons and each season was assumed as an environment, using randomized block design with three replications. The data collected were analysed using biplot analysis of genotype plus genotype × environment interaction (GGE) and additive main effects and multiplicative interaction (AMMI). Significant genotype, environment, and G × E interaction was found in the AMMI ANOVA for seed yield per plant (gms) of 32 greengram genotypes. Genotype (G3) Pusa 1031 exhibited high seed yield adaptability for the environment E1 (ICAR NEH farm), E4(NBPGR farm) and E5 (CPGS-AS farm). The NBPGR farm (E4) was shown to be the most suitable for the potential expression of seed yield. The genotypes G3 (PUSA 1031) and G28 (Ganga-1) are stable and high yielding across the locations according to the stability analysis results.

Keywords: *Greengram, Acidic Soils, AMMI, GGE*

T3A-30

Studies on the effect of growth hormones on softwood cuttings of Guava (*Psidium guajava* L) Var lucknow-49

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Abstract

The present investigation entitled "studies on the effect of growth hormones on softwood cuttings of guava (*Psidium guajava* L.) Var lucknow-49". was carried out at Floriculture Research Station, Rajendranagar, SKLTSHU-Hyderabad during January 2023 to August 2023. The experiments were conducted in CRD with 10 treatments and 04 replications under mist chamber. The apical softwood cuttings were collected from shoot tips measuring about 10 to15 cm treated with different hormones of concentrations viz., IAA @ 2000, 3000 and 4000 ppm; NAA @ 2000, 3000 and 4000 ppm along with IBA @ 3000, 4000 and 5000 ppm and these were compared with control. The treated softwood cuttings were planted in 40 cavity protrays and kept till 30 days for root induction under mist conditions. The different growth hormonal applications and its varied concentrations exerted a significant effect on root development in cuttings. Softwood cuttings treated with IBA @ 5000 ppm was found better for rooting percentage (69.90 %), survival percentage (67.50 %), time taken to root (23.75 days), number of roots per cutting (15.15, 16.25, 17.53 and 24.64) and root length (7.33, 9.78, 13.85 and 18.33 cm) respectively at 30, 60, 90 and 120 DAP, fresh root weight (3.93 and 10.15 g), dry root weight (1.13 and 2.18 g) at 60 and 120 DAP, respectively. The growth hormone IBA performed better in formation of rooting in softwood cuttings when compared to IAA, NAA and untreated control. The hormonal treatment with IBA @ 5000 ppm performed better in propagation of softwood cuttings when compared to IAA, NAA and untreated control. This experiment revealed the potentiality of guava propagation through softwood cuttings it will be a novel, economical method to propagate for mass production.

Keywords: *Guava, softwood cuttings, Growth hormones, IBA*

T3A-31

CRISPR/Cas9 in Crop Improvement

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Abstract

The Green Revolution and improved agricultural practices has impacted multifold increase in food production on one hand but led to the narrowing of genetic base of cultivated crops on the other hand. The latter calls for the need to create additional variation that may be brought about by several approaches like classical breeding, mutation breeding, transgenic approach and the recent genome editing approach. Genome editing is a novel approach in which nucleotide sequences can be inserted, deleted or replaced from a genome using artificially engineered nucleases. Currently four families of engineered nucleases are being used *viz*. Mega-nucleases, Zinc finger nucleases (ZFNs), Transcription Activator-Like Effector Nucleases (TALENs) and a RNA guided nucleases *i.e.* clustered regularly interspaced short palindromic repeat (CRISPR)/Cas9 (CRISPR-associated) system. These nucleases create site specific double-stranded break (DSBs) at targeted location in the genome and triggers the cell's endogenous mechanisms to repair the induced break either by homologous recombination (HR) or by non-homologous end joining (NHEJ). The latest ground-breaking technology for genome editing is based on RNA-guided engineered nucleases, commonly known as CRISPR/Cas9, from bacterium *Streptococcus pyogenes* which is most widely used in genome modification). This technology is being utilized to avoid contamination in hybrid seed by selfed seed of sterile line in two-line system of hybrid rice production. The rice Bentazon Sensitive Lethal (BEL, LOC_Os03g0760200) gene confers resistance to bentazon and sulfonylurea herbicides. The loss-of-function mutant *bel* is sensitive to herbicides. Therefore, *BEL* gene was disrupted using sgRNA: Cas9-based modification. Crop improvement requires constant creation and use of new allelic variants that can be achieved by ZFNs, TALENs, and CRISPR/Cas9. Genome editing using these transformative tools has the potential to revolutionize biological research and can be used as a novel instrument to manipulate the genome that can influence crop yield, quality as well as resistance to diseases and pests.

Keywords: *Gene editing, CRISPR/Cas9, Precision breeding, Biotechnological advancement, ZFNs, TALENs*

T3A-32

Effects of Organic manures and Inorganic fertilizers on Growth, Fruit Yield and Quality of Cherry Tomato (*Solanum lycopersicum* var. *cerasiforme*) c.v. Pusa Cherry Tomato-1 under Naturally Ventilated Polyhouse Condition

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Abstract

The present research investigation was conducted in the winter of 2021–2022 at the Naturally Ventilated Polyhouse, Department of Horticulture, SHUATS, Prayagraj (U.P.), in order to determine the best combination of inorganic fertilizers and organic manures for the growth, fruit yield, and quality of cherry tomatoes. The 13 treatments in the experiment were set up in a randomized block design and were duplicated three times. The treatments included various mixes of inorganic fertilizers and organic manures, such as vermicompost, poultry manure, and FYM (farmyard manure). Treatment T3 (100 percent organic manures; 33 percent FYM, 33 percent poultry manure, and 33 percent vermicompost) is one of the thirteen treatments being studied. recorded maximum plant height (235.20 cm), minimum number of days to first flowering (45.36), minimum number of days to 50% flowering (61.42), maximum number of branches per plant (11.33), maximum number of fruits per cluster (24.17), minimum number of days to first fruit setting (55.97), maximum number of cluster per plant (12.2), maximum average number of fruits per plant (237.53), maximum fruit set percentage (86.65%), maximum fruit weight (13.25g), maximum fruit width (3.04 cm), maximum fruit yield per plant (3.91 kg), maximum fruit yield per hectare (130.59 tonne), maximum TSS (10.64 Brix), maximum Juiciness (27%). T6 (75% RDN + 25% Vermicompost) had the highest number of flowers per cluster (29.33); T11 (25% RDN + 75% Poultry manure) had the highest ascorbic acid content (24.57 mg/100g); and treatment T3 100% Organic Manures (33% FYM + 33% Poultry manure + 33% Vermicompost) had the highest B:C ratio (5.97).

Keywords: *Cherry Tomato, Organic, Yield and Quality*

T3A-33

Exploring Strategies for Cold Resilience in Leguminous Crops

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Abstract

Legume plants produce one-third of the total yield of primary crops and are important food sources for both humans and animals worldwide. Frequent exposure to abiotic stresses, such as drought, salt, and cold, greatly limits the production of legume crops. However, relying solely on agronomic practices is insufficient to adequately support plants in enduring harsh cold conditions. Hence, it is crucial to explore various factors related to plants' response to cold stress, including genetic, epigenetic, physiological, and cellular aspects. Recent progressions have yielded comprehensive insights into the intricate mechanisms governing cold stress. Identification of Quantitative Trait Loci (QTLs), genes, and proteins associated with cold stress tolerance holds promise in enhancing or developing stress-resilient legume cultivars. One

such synteny analysis revealed the conservation of frost tolerance QTLs between faba bean and other legume species, suggesting a partial conservation of the genetic control of frost tolerance among different legume species. Further insights revealed the identification of major QTLs and distinct RILs involving frost tolerance, providing potential targets for marker assisted selection or as potential candidates for breeding. Aquaphotomics is a novel approach that has been recently applied to study the cold stress response in legumes which is also rapid and non-destructive. This technique uses near-infrared (NIR) spectral analysis to detect changes in the water molecular system of plants under stress. The results contribute to a better understanding of the physiological role of water in plant adaptive response to temperature change and provide insights into the cold tolerance ability of different soybean cultivars. This review discusses various approaches that significantly help to develop climate resilient crops.

Keywords: *Cold Stress, Legumes, Tolerance Mechanisms, Gene Expression, Crop Enhancement*

T3A-34

Nitrogen and Phosphorus interplay in plants: A molecular approach

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Abstract

Nitrogen (N) and phosphorus (P) are the two most abundant mineral nutrients for plants, and their coordinated acquisition is vital for plants to achieve nutritional balance and optimal growth under a fluctuating nutritional environment. The uptake of N or P affect each other,mindicating the strategy that has evolved for maintaining N–P nutritional balance in plants. Nitrate and phosphate are the major sources of N and P for plants, and they also act as the signal molecules to trigger downstream N or P responses. Their respective signalling pathways have been well studied in both Arabidopsis and rice. Phosphate signalling is usually studied in terms of induction of phosphate starvation. The MYB-CC transcription factor AtPHR1 (in Arabidopsis) and OsPHR2 (in rice) act as central regulators to activate expression of phosphate starvation-induced (PSI) genes. The repressor protein OsSPX4, which is degraded under phosphate starvation, can interact with OsPHR2 to block its cytoplasmic–nuclear shuttling. Thus, the OsSPX4–OsPHR2 module explains the mechanism of phosphate starvation signal transduction. Nitrate is sensed by the dual-affinity nitrate transporter AtNRT1.1/CHL1/ AtNPF6.3 through the phosphorylation of Thr101; this step is regulated by the concentration of nitrate and modulates the primary nitrate response in Arabidopsis. In rice, OsNRT1.1B, the functional homologue of AtNRT1.1, has also been demonstrated to mediate nitrate signal transduction. Finally, N and P interconnections are complex traits that plants evolved in natural environments. The identification of the molecular elements that integrate N and P signals brings us closer to the understanding of an evolved logic gate in plant cells which open research avenues toward the uncoupling of these signaling pathways to adapt genotypes to particular agricultural conditions.

Keywords: *Phosphate Starvation Induced genes, Repressor protein, Transcription factor*

T3A-35

Genetic diversity of sweetpotato geneotypes revealed by SSR Markers

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Abstract

North-eastern region of India is renowned for its unique culture and is recognized as a vital biodiversity hotspot, rich in plant species. Sweet potatoes, an important tuber crop cultivated globally, particularly by small and marginalized farmers, serving as a vital tool in addressing malnutrition and supporting underdeveloped nations. To optimize the use of germplasm for breeding, understanding its genetic diversity is essential. This study examined 31 sweetpotato genotypes using 21 simple sequence repeat (SSR) markers. A total of 704 amplicons were identified, averaging 33.52 per marker. Band frequency ranged from 0.33 to 0.69, and polymorphic information content varied from 0.03 to 0.61. Using the Dice similarity coefficient, the 31 genotypes clustered into three primary groups, with similarity scores ranging from 0.09 to 0.92. Further analysis revealed nuanced relationships within these clusters. Population structure analysis identified two well-stratified subpopulations, Subpop1 and Subpop2, with Fst values of 0.49 and 0.23, respectively. Average distances within Subpop1 and Subpop2 were 0.26 and 0.33, respectively, with an estimated allele-frequency divergence of 0.21. .The SSR markers utilized in this study proved informative and polymorphic, providing valuable insights into sweetpotato genetic diversity. These markers hold significant potential for enhancing breeding programs aimed at improving elite progenies in the future, thereby contributing to sustainable agricultural practices and food security worldwide

Keywords: *Sweet potato, SSR markers, Genetic diversity*

T3A-36

Food fortification in India: Prospects and challenges

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Abstract

Food Fortification is the addition of vitamins, minerals and other essential micronutrients to staple food e.g. rice, wheat oil etc. Food Fortification at the global level is necessary due to major issues like malnutrition as around 2 billion people suffer malnutrition including women and children less than 5 years of age (Global Nutrition report, 2016). Some other reasons for food fortification are diseases like Night Blindness, Goitre, Anaemia which are caused due to lack of vitamins. India ranked 111 in the latest Global Hunger Index, 2023 (WHO, 2023). It is estimated that 1 rupee spent on fortification results in 9 rupees benefit to the economy (Copenhagen Consensus, 2018) and it is also a very safe method for improving nutrition among people. In 1953, India launched Vanaspati to fulfil deficiency of Vitamin A & D, in 1962, Salt with iodine was launched and in 2000, Wheat flour was launched to fulfil Iron and Folic acid requirements. There are 3 types of food fortification viz. Mass fortification, Targeted fortification and Market driven fortification.The global Food Fortification market was valued at USD 88.24 Billion in 2022 and growing at a CAGR of 9.64% from 2023 to 2032 (Market Research Report). The market is expected to reach USD 221.49 Billion by 2032. Danone, RFM, Yakult, Friesland Campina, HUL, Meiji, Kellogg's and Nestle are some of the market leaders for fortified foods at the global level and ITC, HUL, Britannia, Pillsbury, Patanjali and Nestle are major players in the Indian market. Some fortified products available near us are viz. Aashirvaad Fortified Chakki Atta, Tata Salt Plus, Patanjali Kachi Ghani Oil, etc. FSSAI provides Fortified Logo to the products abiding these standards and then they are launched as fortified products in the market. GoI has also undertook many schemes like Mid- Day Meal in government schools and using fortified foods in Public Distribution systems. Therefore, prospects in Indian market for food fortification are that India will become the third largest consumer market in the world, there is development of health awareness among the people, government is focusing on food fortification and it has helped eradicating malnutrition. But still this industry is facing many challenges like supply chain management, infrastructure etc. which needs to be addressed for the health prosperity of population and growth of food industry.

Keywords: *Fortification, Malnutrition, Health Awareness, Public Distribution System*

T3A-37

Biofortification of Horticultural crops: a long-term strategy for India's Nutritional Security

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Abstract

There are about 800 million people who are undernourished, but many more—particularly in developing nations—suffer from micronutrient malnutrition, commonly referred to as "hidden hunger" A proper quantity of nutrients are necessary for our body to function normally for a healthy life. Malnutrition has become a global issue. The intake of imbalanced and inadequately nutritious food is the main cause of malnutrition. The main problems that most of the world's nations facing are growing populations, insufficient nutritious food, hunger and malnourishment. Widespread incidences of iron and zinc deficiencies in the population of India are linked to the production of horticultural crops like vegetables and fruits and staple food grains deficient in these minerals, which are acknowledged as the primary causes of malnutrition in humans. Vegetables, fruits and other staple crops are biofortified using three primary methods: genetic engineering, agronomic approach, and conventional breeding. These approaches hold great potential for treating deficiencies in vitamins and micronutrients. Traditional agricultural practices can improve the nutritional content of plant foods to some extent while biofortification is the process of fortifying nutrient in food crops using agronomic, conventional, and transgenic breeding methods to provide a long-term, sustainable solution to the negative effects of vitamin and nutrient deficiencies. A significant number biofortification works has been done in horticultural crops for example in cauliflower (Pusa Beta Kesari, rich in provitamin-A), potato (Kufri Neelkanth, rich in anthocyanin), pomegranate (Solapur Lal, rich in Fe, Zn and vitamin-C). Studies on the feasibility and effectiveness of biofortification, along with recent advancements in delivery, indicate that this approach holds a strong promise in the fight against hidden hunger.

Keywords: *Biofortification, malnutrition, transgenic, Iron, Zinc.*

T3A-38

Role of climate smart agriculture and its impact on futuristic agricultural sector

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Abstract

Climate-smart agriculture (CSA) is an approach that helps to guide actions needed to transform and reorient agricultural systems to effectively support development and ensure food security in a changing climate. As the population is growing exponentially whereas food production in many parts of the world is struggling to keep up due to various reasons among

which climate change has a prominent effect so far, the growing food demand seeks affirmative and promising steps to maintain the gap between production and demand of food. The idea is to challenge the existing and probable climate change and develop agriculture in such a way as to provide maximum food security along with sustainability, which is the basis of futuristic agriculture. These can be achieved with the help of various tools which includes Precision Agriculture through Remote Sensing, GPS (Global Positioning System), GIS (Geographic Information System), DBMS (Database management system), etc. Along with that, reducing GHGs (Greenhouse gases) amidst on-farm activities is a major challenge for which research and innovation is a major quest. New varieties created through various breeding programmes and biotechnological innovations have enabled to solve the problems at the causal site itself. Changing climate adds to the risks of disease susceptibility, pest infestations, acclimatization problems, etc. These risk mitigation programmes together contribute to Climate Smart Agriculture, an approach to maintain sustainability and food security amidst climate constraints.

Keywords: *Climate change, Methanogens, Precision Agriculture, GPS, GIS, DSS, Integrated farming system*.

T3A-39

Improvement of gladiolus (*Gladiolus species*) through *In- vitro* culture and advanced biotechnology

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Abstract

Gladiolus, commonly known as Queen of bulbous flower, is an important cut flower used for its beautiful spikes. With more than 30,000 different cultivars being grown, it ranks 8th among cut flowers. However, gladiolus is propagated by corms traditionally which hastens the multiplication and commercialization of the crop. With the advancement in modern biotechnology and tissue culture, large scale proliferation has been achieved. The important growth and development parameters required for in vitro gladiolus and cormel development have been highlighted in this current review. Various techniques such as in vitro mutagenesis, selection of pest resistance, in vitro identification and selection of pest resistance to develop virus-free virus germplasm, cryopreservation, identifying virus diseases by RT-PCR, somaclonal variation, protoplast and somatic hybridization are being given importance in crop improvement. The application of molecular markers is being discussed by several researches globally for the clonal stability analysis, genetic diversity analysis etc. This will aim to give insight into the comprehensive review for invitro propagation of gladiolus and highlight the advancing tissue culture as well as biotechnological tools in the crop improvement of gladiolus crop.

Keywords: *Biotechnology, bulbous, improvement, highlight*

T3A-40

Deep Learning in yield analysis: A smart step towards futuristic agriculture

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Abstract

Artificial Intelligence has solidified its existence in countless sectors of this world. Going with the flow, agriculture has also got the touch of artificial intelligence in many operations under its wing. One of such AI used in agriculture is deep learning technology. Agriculture has advanced from prehistoric times to the era of modern smart technologies by adopting fresh innovations that have come along. The developing deep learning technologies are one example of this class. Agriculture is one of the fields where deep learning, a type of machine learning that makes data processing easier in a manner similar to that of human brains, is having a significant impact. Deep learning is a fairly recent, revolutionary method of image processing and data analysis that offers a lot of opportunity. Deep learning has proven to be beneficial in several agriculture-related divisions, resulting in a notable increase in work efficiency. Several deep learning approaches are used to address a range of agricultural challenges, which include fruit and plant classification, detection of diseases and authentication, and fruit counting. Crop yield potential analysis represents one of the main developments of deep learning technologies for agriculture. Yield prediction is the most crucial element involved in successful agriculture. A multilayered neural network is used in deep learning to analyse data. Deep learning techniques have been used in quite a few agriculture-related studies, leading to the development of various useful and novel models for assessing the potential for yield of target crops, including some important ones like paddy, wheat, potato, barley, and so on. For estimating agricultural productivity, convolutional neural networks (CNN) in addition to long short-term memory (LSTM) constitute the two most popular deep learning methods.

T3A-41

Investigating the Influence of Sex Ratio on Breeding Success in Captive Mola Carplet (*Amblypharyngodon mola*) with Synthetic Hormone Administration

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Abstract

Mola Carplet, a small indigenous freshwater fish with asynchronous spawning behavior, poses challenges to sustained production despite being listed as a species of "Least Concern" by the IUCN. Understanding how sex ratios influence reproductive success is crucial for effective captive breeding programs of Mola Carplet (*Amblypharyngodon mola*). The reproductive success of captive fish populations is influenced by various factors, including sex ratio and hormonal manipulation. This study aimed to investigate the impact of sex ratio on reproductive success in captive Mola Carplet (*Amblypharyngodon mola*) populations, supplemented with synthetic hormone administration to stimulate breeding. Controlled laboratory experiments were conducted using Mola Carplet populations maintained in tanks with different male-to-female sex ratios: 1:1, 1:2, and 1:3. Additionally, synthetic hormones were administered to selected groups to assess their effects on breeding success. Key parameters such as spawning frequency, egg production, fertilization rates, and offspring survival were monitored and compared across the different treatments. The results revealed that the 1:2 female-to-male sex ratio treatment group exhibited the highest reproductive success, characterized by increased spawning rate (90%) and higher fertilization rates(75%) compared to other sex ratio groups. These findings highlight the importance of sex ratio management and hormonal manipulation in optimizing reproductive success in captive Mola Carplet populations. By maintaining balanced sex ratios and supplementing with synthetic hormones when necessary, aquaculturists and conservationists can enhance breeding outcomes and contribute to the sustainability of Mola Carplet populations. Additional research is needed to better understand the underlying mechanisms and improve breeding protocols for Mola Carplet (*Amblypharyngodon mola*).

T3A-42

Assessing the Impact of Sex Segregation on Reproductive Success in Captive Mola Carplet (*Amblypharyngodon mola*) with Synthetic Hormone Administration

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Abstract

Amblypharyngodon mola (Hamilton Buchanan, 1822) is a small indigenous freshwater fish that lives in several freshwater bodies. It is sometimes referred to as mola, mola carplet, or mowka. This species is a member of the Cyprinidae family. The International Union for Conservation of Nature (IUCN) presently lists the mola carplet (*Amblypharyngodon mola*) as a species of "Least Concern" (Chaudhury, 2010). Despite being listed as a least concern species at the moment, both manmade actions and natural factors are contributing to the species' declining natural abundance. This species has asynchronous spawning, which is one of the main constraints to the sustained production of mola. Despite the fact that this species is self-recruiting, hormone manipulation is necessary for aquaculture and conservation purposes. Induced breeding of *A. mola* was carried out using Ovatide hormone @range of 0.6ml to 0.8ml/kg for both male and female brood fishes. In this Experiment, male and females was segregated prior to breeding. Two batch of breeding experiment was carried out where 1st batch was without segregation and 2nd batch was 14 days segregation of male and female and then breeding. Fishes were spawn at different latency period for each batch i.e. 6 hrs and 6 hrs 15 mins. Here we found out that 14 days segregation prior to breeding shows a better performance than without segregation with females' highest egg yield 4100 nos., Spawning rate 100%, Fertilization rate 75% than without segregation with females' average absolute fecundity 3826 nos., 66.6% spawning rate and fertilization rate 75%.

Keywords: *Induced breeding, Small Indigenous Fish, Amblypharyngodon mola, Sex segregation synthetic hormone*

T3A-43

Biofortification of Rice for increased Zinc and Iron content

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Abstract

Rice (*Oryza sativa* L) being the staple food for almost two-thirds of the population plays a pivotal role in Indian economy. Rice is also a major dietary carbohydrate source for more than half of the world's population. Research focused on development of high-yielding varieties and adoption of modern production technologies resulted in enhanced production leading to self-sufficiency in the country. Biofortification of rice with micronutrient elements has the potential to combat widespread micronutrient deficiencies in humans. Rice biofortification program aims at biological and genetic enrichment of food products with vital nutrients, vitamins and proteins through conventional breeding or biotechnological approaches. Biofortification can be a cheaper and effective alternative to traditional ways of combating

micronutrient deficiencies. The micronutrient transport in rice is controlled at several stages, including uptake from soil, transport from root to shoot, careful control of subcellular micronutrient transport, and finally most importantly, transport to seeds. To enhance micronutrient accumulation in rice seeds, we need to carefully understand and regulate all these processes. The lack of dietary diversity among poor communities has led to nutritional consequences, particularly zinc deficiency. Zinc is considered as one of the micronutrients essential to improve human health and reduce the risk of malnutrition. The first set of high-Zn rice varieties has been released in Bangladesh, India, Philippines and Indonesia. Efforts have begun to mainstream grain Zn to ensure that Zn trait becomes an integral part of future varieties. Dietary iron deficieny also affects 14% of the world's population with significant health impacts. Insertion of a single or multiple genes encoding iron storage protein, metal transporter, or enzyme involved in the biosynthesis of metal chelator in the rice genome was shown to be a viable approach to significantly increase grain Fe density. Ideally once rice is biofortified with the vital nutrients, the farmer can grow the variety indefinitely without any additional input to produce nutrient packed rice in a sustainable way so that the produce reaches the malnourished population in rural India and mitigate the widespread nutrient deficiencies.

Keywords: *Biofortification, Iron, Zinc, Micronutrient, Deficiency*

T3A-44

Successful wide hybridization of pungent *Capsicum* landraces of Northeast India

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Abstract

Chilli landraces of the northeast region exhibits diverse fruit shape, size, colour and pungency. Among the common species *Capsicum chinense* (Bhoot Jolokia/Naga Chilli/Umorok) and *C. frutescens* (Bird's eye chilli) are the two species which are known for their pungent trait with high capsaicin content but hybridization barrier exists between them. *C. chinense* fruit have moderately triangular with broad base and tapering tip with straight to low curvature apex (medium to high glossy irregular rough skin) with length of 4.9 -5.5 cm to 3.2 – 3.5 cm with while *C. frutescens* has narrowly triangular (smooth and medium glossy skin) fruit with 3-3.4 m (length) to 0.8 – 1.1 cm (width). Interspecific hybridization is one of the most important approaches for transfer of desirable traits. More than 200 crosses were made in the hybridization attempt using both the species. The hybridity of the plants obtained from the crossed seeds were confirmed comparing important morphological parameters. The resulting hybrid fruits were moderately triangular having smooth texture surface and glossy skin measuring 3.6 – 4.6 cm fruit length and 1.6 – 2 cm width, the fruit also shows medium green colour during unripe mature stage to medium to deep red when ripen. Molecular confirmation was also carried out using polymorphic SSR markers.

T3A-45

Performance of Purple Flesh Sweet Potato Variety Bhu Krishna in Tripura

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Abstract

"Bhu Krishna", a biofortified purple fleshed sweet potato variety was released by ICAR-CTCRI, Regional Centre, Bhubneshwar in the year 2017. The variety has high anthocyanin content (85-90 mg/100g) and it has the ability to grow under medium stress and salinity condition and it is highly tolerant to weevil. Bhu Krishna variety is developed through clonal selection with a maturity period of 110-120 days and yield potential of 18-22 t/ha and it was introduced in Tripura under ICAR-CTCRI NEH project. Purple-fleshed sweet potatoes have anthocyanins that possesses numerous pharmaceutical properties such as radical scavenging, antimutagenicity and efficacy against liver diseases. The present experiment was conducted in the farmers field at Bokafa RD Block, South Tripura during November 2022 to March 2023 with an objective to assess the growth and yield performance of Bhu Krishna under Tripura condition. Five treatments (T1: Bhu Krisha without NPK dose; T2: Bhu Krishna with fertilizer dose of 50:25:50 kg/ha NPK; T3: Bhu Krishna with 3/2 fertilizer dose of T2; T4: Bhu Krishna with ½ fertilizer dose of T2 and T5: Local variety "Tha Ktui" without NPK dose) with four replications each using Randomized Block Design (RBD) was laid out. Two healthy and vigorous vine cuts of 20 cm length having two to three nodes each are planted horizontally per hill and placed 20 cm apart on the ridges. Results of the experiment indicated highest vine length and number of tubers per plant was recorded in the treatment T3 followed by T2 and T4 while average weight of tuber and tuber length was recorded highest in the local variety "Tha Ktui" (T5) followed by T2 and T3. Maximum yield of tuber per ha was found in T3 followed by T2 and T5. Considering above findings, treatment T3 having Bhu Krishna with a fertilizer dose of 75:38:75 kg/ha NPK can be recommended for cultivation in Tripura.

T3A-46

Evaluation of Five Different Species of Oyster Mushroom for their yield potential and different growth parameters under Tripura Conditions of North East India

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Abstract

In India different species of Oyster mushrooms are cultivated depending upon the prevalence of agroclimatic conditions and availability of agro-wastes. The present study was carried out at Mushroom Production Unit, Multi Technology Testing Centre & Vocational Training Centre, College of Fisheries, Central Agricultural University (Imphal), Lembucherra to observe the growth behaviour and yield potential of five different species of Oyster mushrooms viz. *Pleurotus florida*, *P. sajor-caju*, *P. djamor*, *P. ostreatus* & *P. citrinopileatus*. The five species of *Pleurotus* were grown separately on sterilized paddy straw substrate in dark growing rooms at 20-25˚C temperature and 80-85 % relative humidity during the months of October-December, 2023 and January to March, 2024. Data obtained revealed that the total cropping periods was varies from 46 days to 58 days i.e. 46 days in *P. florida*, 49 days in *P. sajor-caju*, 52 days in *P. djamor*, 55 days in *P. ostreatus* and 58 days in *Pleurotus citrinopileatus.* The fastest spawn run was recorded in *P. florida* i.e. 17.5 days followed by *P. sajor-caju* i.e. 19.5 days, *P. djamor* (21.0 days), *P. ostreatus* (23.0 days) and *Pleurotus citrinopileatus* (25.0 days). Similarly, the early pin head initiation was recorded in *P. florida* i.e. 20.5 days followed by *P. sajor-caju* i.e. 22.5 days, *P. djamor* (24.3 days), *P. ostreatus* (26.5 days) and *Pleurotus citrinopileatus* (28.0 days). The highest yield was obtained in *P. florida i.e.* 1.35 kg per kg of dry substrate followed by *P. sajor-caju* i.e. 0.98 kg per kg of dry substrate, *P. djamor* (0.90 kg/ kg dry substrate), *P. ostreatus* (0.84 kg/ kg of dry substrate) and *Pleurotus citrinopileatus* (0.72 kg/ kg of dry substrate). Further analysis of results revealed that the *P. florida* has biggest average stalk length (3.2 cm), average stalk diameter (1.0 cm), average cap diameter (7.4 cm), and maximum weight of fruiting body (44.0 g), was followed by the *P. sajor-caju*, in *P. djamor*, *P. ostreatus* and *Pleurotus citrinopileatus* respectively.

T3A-47

Evaluation and selection of superior germplasm of mango from Manipur, North East India

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Abstract

Present investigation was carried out during 2017-2024 to find out superior genotypes of local mango germplasm found in valley region of Manipur based on NBPGR descriptor. Observation recorded 5 superior /elite local genotypes having specific traits like precocious flowering, late bearing, good quality of high TSS and fibreless traits. This selected superior germplasm are vegetative propagated from the selected mother plants and conserved having the IC No. 0642153 – 0642156 obtained during 2022 and IC No. 651315 during 2024 from NBPGR, New Delhi for crop improvement works for the future.

Key words: *Mango, local genotypes, superior genotypes, conservation*

Theme 4; Soil and water resources and its sustainable management

T4A-1

Land use change analysis in a Himalayan watershed using remote sensing and GIS

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Abstract

The Himalayan regions are active geographically characterized by young fragile ecosystem along with the inherent environmental problems of natural occurrence such as, soil erosion, earthquakes, landslides and flash floods. Moreover, the hydrologic condition of watershed is also changing with time owing to dynamic change in land use condition due to urbanization, agriculture expansion, deforestation, afforestation and implementation of conservation measures. This change of land use has a considerable impact on the runoff characteristics and related hydrological processes and therefore it is quite necessary to map like the change of land use in the watershed in order to formulate the developmental strategy. In the present study, the temporal land use change analysis in Bino watershed which is situated in Almora and Pauri Garhwal districts of Uttarakhand, India during span of ten years (2000-2009) using remote sensing and GIS techniques. The land use/land cover map of Bino watershed for 16 September, 2000 and 23 September, 2009 were prepared using the satellite imageries of LANDSAT 5 TM by unsupervised image classification in ENVI 4.7 software. The major land use/land cover classes found in the watershed include dense forest, open forest, agricultural land, waste land, built-up area and water body. It was found that out of total geographical area of 296.366 Km^2 under study, the highest percentage of 36.75 % was covered by dense forest followed by open forest (22.64 %), agricultural land (21.71%), waste land (14.43 %), built-up (4.32 %) and water body (0.14 %) in the year 2000. While in the year 2009, 29.15 % of total area was occupied under open forest which was followed by dense forest (27.17 %), agricultural land (25.75 %), waste land (10.57 %), built-up (7.08 %) and water body (0.28 %).The annual land use change index (LI) was found to vary from 1.86 (agricultural land) to 9.87 (water body) over the ten years.

Key words: *Land use land cover, watershed, Remote Sensing, GIS*

T4A-2

Agronomic Management Strategies to Mitigate Greenhouse Gas Emission from Rainfed Rice

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Abstract

Approximately 1.3% to 1.8% of anthropogenic greenhouse gas emissions (GHG) and over 10% of worldwide agricultural GHG emissions are caused by rice cultivation. This has resulted in many environmental disruptions such as global warming, climate change, deterioration in sustainable production systems, thus, finding out some set of agronomic strategies to reduce or mitigate these emissions is crucial. Keeping this in view, a study was conducted at the experimental field of COA, CAU Imphal in 2021 and 2022 *Kharif* seasons in order to study the effect of establishment techniques and nutrient managements on emission patterns of 3 greenhouse gases *viz*., CH_4, CO_2 and N_2O and the Global warming potential (GWP) was also worked out. Treatments comprised of 4 levels of rice establishment technique *viz*., direct seeded (broadcasting) (E_1), direct seeded (line sowing) (E_2), Transplanting (random) (E_3), Transplanting (line) (E_4) and three levels of nutrient management i.e. Chemical@60:40:30 kg NPK/ha (N_1), Organic@10t/ha FYM (N_2) and Integrated nutrient management @30:20:15 kg NPK/ha + 5t/ha FYM (N_3). Pooled results revealed that highest CH_4 emission was from E_4 and was at par with E_3 while highest amount of CO_2 and N_2O was emitted from E_1. On the other hand, least CH_4 and CO_2 flux was recorded in E_2 and E_3 respectively and N_2O emission was lowest in E_4. In case of nutrient managements, N_2 recorded significantly higher CH_4 and CO_2 emissions and N_1 recorded the lowest. However, highest N_2O emission was recorded in N_1 and lowest in N_2. Also, significantly highest GWP was recorded in E_4 and N_2 while the lowest in E_2 and N_1. Thus, this study indicates that in order to reduce GHG emission, direct seeding rice establishment method in conjunction with combined application of chemical fertilizers at 30:20:15 kg NPK/ha and FYM@5t/ha simultaneously as an INM approach can be used as a mitigation option.

Keywords: *Greenhouse gases, Global Warming Potential, Rainfed rice*

T4A-3

Bioprospecting cyanobacteria from paddy soils of Assam

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Abstract

The bioresource potential of filamentous cyanobacteria from rice fields of Assam was studied. Rhizospheric soil samples were collected randomly from Jorhat and Golaghat districts of rice rhizosphere, of which 30 cultures thus showed pure colonies. The selected cultures were morphologically characterised on the basis of thallus morphology, trichome, vegetative cell structure, presence or absence of heterocysts and akinetes. The results showed that the cultures were non identical to each other and morphological data and microphotograph thus revealed probable genera belonging to *Anabaena, Nostoc, Cylindrospermum* and *Calothrix.* The soil nutrient status and soil enzyme assays as influenced by the various cyanobacteria indicated variation among the soil from where cultures were isolated. The nitrogenase enzyme activity was determined using ARA and results revealed a range of 7.70- 26.19 C_2H_2 nmol ml^{-1} hr^{-1} day^{-1} and culture BGA- 41 showed as the efficient culture. Most of the cyanobacterial cultures exhibited positive results for siderophore production, HCN production and proteolytic activity. Quantitative activities of P solubilization and ammonia production was highest shown by BGA- 41. 10 efficient cultures based on enzyme and PGP activities were selected for pot experiment in rice crop variety Luit (Ahu) and all cultures showed better growth and yield as compared to the uninoculated control which was evident from the data obtained on number of tillers, number of panicles, length of panicles, grain yield (g/ hill), straw yield (g) and dry weight of root (g). BGA- 41 was shown superior to other cyanobacterial cultures which was at par with the recommended fertilizer dose treatment.

T4A-4

Optimizing growth and yield *of Azolla microphylla*: Comparative effects of organic matter levels

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Abstract

Tremendous zeal *en route* to organic as well as natural farming has been fostered in the last half-decade. The *Azolla*-cyanobiont association has drawn immense interest amidst the scientific community and agriculturists owing to its proven potential use. It can be adopted as an alternative or partial substitute to nitrogen fertilizers, which would play a pivotal role in the country's odyssey of *Atma Nirbharta*. Additionally, incorporation of *Azolla* as a green manure upsurges the organic matter and potassium content of soil, presence of *Azolla* mat on surface of water bodies has been shown to significantly diminish weed dominance, limit evapotranspiration and reduce volatilization of applied N fertilizers. Significant constraint in popularizing it is the copious amount of biomass requirement. The present investigation intended to experimentally evaluate the response of *Azolla microphylla* to different levels of organic matters. The study was undertaken in cemented tanks arranged in Completely Randomized Design with 10 treatments in triplicates for 60 days. The treatments encompassed vermicompost, compost and FYM in three different levels each viz; 1.0, 1.5, and 2.0 kg; and control. Developmental indices *viz*; fresh weight, dry weight, chlorophyll content, root length, frond size, heterocyst per cent, N per cent and P per cent were recorded at 15, 30, 45, and 60 days interval. It was observed that all indices except root length were significantly higher with the supplementation of compost at the rate 2.0 kg/tank followed by that of 1.5 kg/tank and 1.0 kg/tank. On the contrary, maximum root length was recorded in 2.0 kg/tank of FYM treatment. Control treatment gave the lowest values in all parameters recorded indicating the need for nutrient supplementation. It is inferred from the experiment that compost supplementation at the rate of 2.0 kg/tank can be served as a good system for enhancing growth and production of *Azolla microphylla.*

Key words: *Azolla microphylla*; *organic matter; vermicompost; compost and FYM*

T4A-5

Sustainable Soil Use and Its Management: A Comprehensive Approach

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Abstract

Sustainable soil use and management are critical for ensuring long-term agricultural productivity, environmental health, and food security. This abstract provides an overview of key principles and strategies for achieving sustainability in soil management practices. Firstly, sustainable soil management involves preserving soil health by minimizing erosion, nutrient depletion, and chemical contamination. This can be achieved through practices such as crop rotation, cover cropping, and reduced tillage, which enhance soil structure, fertility, and water retention capacity. Secondly, integrating agroecological principles into farming systems promotes biodiversity and resilience, reducing the reliance on synthetic inputs and enhancing natural pest control mechanisms. This approach fosters a more harmonious relationship between agriculture and the environment, leading to improved soil health and ecosystem services. Furthermore, adopting

precision agriculture techniques, such as soil mapping and sensor-based monitoring, allows for targeted application of inputs, optimizing resource use efficiency and minimizing environmental impacts. Additionally, promoting soil conservation and restoration efforts, including reforestation, erosion control measures, and rehabilitation of degraded lands, is essential for reversing soil degradation and enhancing ecosystem resilience to climate change. Finally, fostering interdisciplinary collaboration and knowledge sharing among scientists, policymakers, farmers, and other stakeholders is crucial for developing and implementing effective soil management strategies that are tailored to local contexts and promote sustainability across agricultural landscapes. In conclusion, sustainable soil use and management require a holistic approach that integrates ecological, agronomic, and socio-economic considerations to safeguard soil health, enhance agricultural productivity, and ensure the well-being of present and future generations.

Keywords: *Sustainable soil, Crop rotation, Cover cropping, Reduced tillage, Soil health and Precision Agriculture*

T4A-6

Multifaceted plant growth promoting bacteria containing ACC-deaminase activity confer better fitness to rice seedlings under pH stress

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Abstract

This study determined how the pH stress (4.0, 5.5 and 6.8) of growth medium influence the plant growth promoting (PGP) traits of bacteria containing 1-aminocyclopropane-1-carboxylate deaminase activity (+ACCD) and lacking ACCD activity (-ACCD), those inhabitant of rhizosphere and root tissues of rice plants from strongly acid soils (pH 4.5 to 5.2). Out of 200 bacteria screened for acidity tolerance, only 70 isolates could grow at pH 4.0 indicating 35% incidence of acid tolerant bacteria (ATB) associated with rice rhizosphere and root tissues. Among ATB, 20 isolates possessed the ACCD activity (22.8 to 191.4 ηmol α-ketobutyrate mg^{-1} protein h^{-1}) at pH 5.5 and referred them as +ACCD group. From remaining 50 ATB, 20 isolates were randomly selected and referred as –ACCD group. The higher pH stress had significant negative effect on the PGP traits (IAA-production, dissolution of $Ca_3(PO_4)_2$, $FePO_4$, $AlPO_4$, and $ZnPO_4$, and mineralization of Na-phytate) of isolates from both ACCD groups. Though +ACCD and –ACCD groups didn't differ significantly on above PGP traits, the exceptions were: +ACCD group possessed the significant higher ability for mineralization of Na-phytate and the significant lesser dissolution of $Ca_3(PO_4)_2$ than that of –ACCD group. The extent of benefits on rice seedling growth due to inoculation with +ACCD bacterium was significantly greater than inoculation with –ACCD bacterium under high pH stress condition, but such benefits of +ACCD bacterium became obscure under reduced pH stress condition. In conclusion, the screening of bacteria for PGP traits should consider the pH of growth medium similar to the pH of natural habitat of bacteria. The benefit of inoculation of +ACCD bacterium to rice seedlings was more prominent under higher acidity stress than inoculation with –ACCD bacterium.

Keywords: *pH Stress; Plant Growth Promoting; Rhizosphere; ACCD*

T4A-7

Phenotypic Characterization of Plant Growth Promoting Microbial Isolates from Maize Rhizosphere and Phyllosphere

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Abstract

The present investigation entitled "Phenotypic characterization of plant growth promoting microbial isolates from maize Rhizosphere and Phyllosphere" was carried out at the Department of Soil Science and Agricultural Chemistry at Acharya Narendra Deva University of Agriculture & Technology (ANDUAT), Kumarganj, Ayodhya (U.P.). Six samples from rhizospheric soil and phyllosphere were collected from two experimental field sites under Maize crop, cultivated during *Kharif*, 2021 season at student's Instructional farm at 80 DAS. Upon analysis of physicochemical properties like BD, pH and EC these samples were found to be statistically at par. Values for organic carbon, Microbial Biomass carbon and total protein content followed a similar trend with the data from different samples. Upon serial dilution plate count it was observed that the total number of rhizospheric bacterial population 12-69×10^6 cfu g^{-1} of soil, fungal population 5.3-7.3×10^3 sfu g^{-1} of soil, actinomycetes population 3.9- 8.0 ×10^4 cfu g^{-1} of soil and the total number of phyllospheric bacterial population 0.2- 4.7×10^5 cfu g^{-1} of sample, fungal population 1.9- 4.9 ×10^2 sfu g^{-1} of sample, actinomycetes population 4.8- 6.7 ×10^2 cfu g^{-1} of sample. A total of 6 bacterial 2 actinomycetes and 2 fungal strains were isolated from rhizospheric soil samples whereas 4 bacterial and 2 fungal strains were isolated from Phyllosphere samples of maize crop by serial dilution plating technique. The highest IAA production was observed 26.15 mg IAA ml^{-1} and the lowest was 22.38 mg IAA ml^{-1}. All the 16 microbial isolates were further compared on the basis of five PGP traits namely HCN, ammonia, antibiotic, antifungal production and seed germination. On the basis of this, the 6 strains (R_1, R_4, R_7, PS_2, PS_3

and PS_4) having the best response were selected for biochemical characterization. These potent microbial isolates showed effective positive responses to different Biochemical traits based on their varied PGP capabilities. Based on the results it can be concluded that based on the multipotent PGP characteristics of the 6 best microbial isolates, these can be used either individually or in different combinations towards formulation of multipotent Bioagent formulations for plant growth promotion and pathogen biocontrol in diverse cropping systems.

Keywords: *Phyllosphere, Phenotypic characterization, Plant Growth Promoting Rhizobacteria, Rhizosphere*

T4A-8

Spatial variability mapping of soil physiochemical properties in Bhoirymbong block, Meghalaya using Geostatistics

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Abstract

Deterioration of soil prompted by poor land management practices is a major constraint towards sustainable land use productivity. Although NEH region the spatial variability mapping of soil properties is crucial because this area is highly undulated and consistently heavy rainfall annually. The present study was conducted in Bhoirymbong block, Ri-Bhoi district, Meghalaya which lies between 25˚42'6''N - 25˚45'21''N latitude, 91˚1'9''E - 92˚05'26''E longitude and 1010 m altitude with covering 19.61 km2 area. The 4-land use and 7 slope classes have been taken for the slope and land use intersection map using ARC-GIS 10.8.2 software. A stratified random soil sampling technique was followed in which a total of 400 composite soil samples within the depth of 0-20 cm were collected in November and December from slope and land use intersection map including 25 strata. Experimental findings revealed that the spatial variability analysis of soil properties was done using a log transformation model because of the lowest coefficient of variation (CV) value compared to none and box-cox transformation. Soil properties such as SOC and available NPK were interpolated. The value for nugget to sill ratio of SOC and available NPK were >0.75 indicating very weak spatial autocorrelation among the variables. Among all geostatistical and deterministic methods, the best-fitted semi-variogram model of SOC and available NPK were circular, spherical, tetraspherical, pentaspherical, exponential and gaussian model of ordinary kriging concerning the R 2 and RMSE value (0.72, 0.84, 0.75, 0.78) and (0.139, 0.078, 0.140 and 0.130) followed by local polynomial interpolation model with (0.69, 0.79, 0.72, 0.75) and (0.142, 0.079, 0.142, 0.135). However, the Spatial variability map of SOC and available NPK was prepared by using OK and LPI techniques. According to the findings of the current study, using geostatistics to illustrate the spatial variability of soil attributes directly would assist farmers and decision-makers in improving soil fertility, soil water management and ecological management. Keywords: Spatial variability, geostatistics, semi-variogram, Spatial autocorrelation.

T4A-9

Unlocking the secrets of micronutrients and its relationship with the physico-chemical properties in orange orchard soil of Tamenglong district, Manipur

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Abstract

Manipur, a state in North Eastern part of India, is famous for Tamenglong Orange which possesses unique flavour and nutritional value. Farmers in the region have grown all the horticultural and agricultural crop organically. As there is reduction in the yield of orange in recent past years reported by the farmers, the experiment was observed with the objective of evaluating the profile distribution of DTPA-extractable micronutrient cations (Fe, Cu, Mn and Zn) and its correlation with several physico-chemical properties of soils in fifteen *orange orchard* of Tamenglong district, Manipur were studied. Most of the upper soil layer had higher DTPA-extractable micronutrient cations (Fe, Cu, Mn and Zn) content than the lower horizons. In the profiles, the value of DTPA- extractable micronutrients (Fe, Cu, Mn and Zn) ranged from 18.62 to 45.12 mg kg^{-1}, 0.12 to 1.26 mg kg^{-1}, 3.42 to 44.33 mg kg^{-1} and 0.16 to 1.36 mg kg^{-1}, respectively. The DTPA-extractable Fe and Mn were found to be sufficiently available in all the profiles whereas Cu was found adequate in most of the surface layer (0-20 cm) in most of the soil samples. However, Zn which deficiency occurred in 26.27 per cent of the soil sample. Multiple regression analysis showed that the DTPA-extractable micronutrient cations (Fe, Cu, Mn and Zn) content in the soils were influenced by pH, OC, EC, Mg, silt, K and clay to the degree of 50.1, 25.7 and 60.5 percent in the surface layer but their influenced were significant only by soil OC and silt.

Keywords: *Orange orchard, Tamenglong, Micronutrients*

T4A-10

Temporal nutrient release pattern of coal-mine affected agricultural soil under different amelioration practices

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Abstract

Potential agricultural soils adjacent to the coal mine affected area of Latyrke village of East Jaintia hills in Meghalaya often endure low soil and plant productivity through unscientific mining activities causing acid mine drainage. The low productivity of soil is mainly due to low pH, high sulphur, increased exchangeable Al^{3+} content, increased levels of extractable heavy metals like Fe, Mn and Cu, lower availability of phosphorus, potassium, zinc etc. Hence, it becomes imperative to identify effective soil acidity amelioration practices in such acid mine drainage affected agricultural soils of the area. Hence, an experiment with a Completely Randomized Design (CRD) has been carried out using two soil acidity ameliorants, namely agricultural lime (Ag. L) and cement kiln dust (CKD). An incubation study was carried out for 100 days using 9 treatments and 3 replications. The treatments include- T1: 100% LR based on ENV of Ag. L, T2: 100% LR based on ENV of CKD, T3: 75% LR based on ENV of Ag. L, T4: 75% LR based on ENV of CKD, T5: 50% LR based on ENV of Ag. L, T6: 50% LR based on ENV of CKD, T7: 25% LR based on ENV of Ag. L, T8: 25% LR based on ENV of CKD, T9: Control. Observations on available nitrogen, available potassium and pH changes were recorded every 20 days over the 100-day period. The peak pH was reached at 40 days for all treatments. The maximum nitrogen availability occurred at 80 days, and potassium peaked at 60 days. It was found that 100% CKD was the most effective treatment, enhancing nutrient availability and raising soil pH to the desired level throughout the incubation period.

Keywords: *Soil Acidity, Lime, Cement Kiln Dust, Acid Mine Drainage, Nutrient Release*

T4A-11

Long term effect of zinc fertilization and crop residue incorporation on soil enzymatic activities in zinc deficient calcareous soils

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Abstract

Broad-scale adoption of the rice-wheat cropping system and inefficient fertilizer use poses a great danger to sustainability and productivity, resulting in negative nutrient balance, lack of micronutrients and degrading soil health over time. Furthermore, widespread zinc deficiency in calcareous soils has resulted in lower agricultural yields. In this context, a longterm field experiment was initiated under the AICRP on "Micro-secondary and pollutant elements in plants and soils" in Zn deficient calcareous soil at RPCAU Research Farm, Pusa, that aimed to study the interactive effect of crop residue incorporation and zinc fertilization on soil enzymatic activities viz., dehydrogenase, acid and alkaline phosphatase, β-glucosidase and urease. Compared to control, the plots receiving 100% crop residues at different levels of zinc fertilization showed a significant increase in dehydrogenase (109.87 µg TPF g-1 24 hrs-1), alkaline phosphatase (60.18 PNP g-1 hr-1), acid phosphates (44.64 PNP g-1 hr-1), urease (43.85 µg N-NH4 + 2hrs−1 g −1) and β-glucosidase (34.99 µg PNP g-1 hr-1) activity. Dehydrogenase activity, alkaline and acid phosphatase activity and urease activity also seemed to be significantly affected by increasing zinc levels. However, β-glucosidase activity with respect to zinc fertilization was found to be non- significant. The CR x Zn (crop residues and zinc) interaction resulted to be significant in the case of dehydrogenase and phosphatases; however non-significant interaction was obtained for urease and glucosidase activity. A highly positive correlation between soil enzyme activities, yield and nutrient uptake was also obtained suggesting the positive role of crop residue incorporation in soil. The incorporation of 100% crop residues in combination with 10 kg Zn kg ha-1 recorded the highest overall rice grain and straw yield followed by 5 kg Zn kg ha^{-1}.

T4A-12

Soil and water resources and its sustainable management

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Abstract

Soil and water resources are indispensable elements of our natural environment, playing pivotal roles in sustaining life and fostering ecosystems. However, rampant exploitation and inadequate management practices have led to significant degradation of these vital resources, posing formidable challenges to global sustainability. This abstract highlight the importance of sustainable management strategies for soil and water resources to ensure their preservation for current and future generations. Effective soil management is crucial for maintaining soil fertility, biodiversity, and overall ecosystem health. Sustainable practices such as conservation tillage, agroforestry, and organic farming promote soil conservation, reduce erosion, and enhance soil structure. Furthermore, adopting precision agriculture techniques minimizes resource wastage while maximizing productivity, contributing to sustainable land use management. Water, as a finite resource, necessitates careful management to meet the increasing demands of a growing population and mitigate the impacts of climate change. Integrated water resource management approaches, including watershed management, rainwater

harvesting, and wastewater recycling, play pivotal roles in sustaining water availability and quality. Additionally, implementing water-efficient irrigation systems and promoting water conservation behaviors are essential for reducing water stress and ensuring equitable access to clean water. The promotion of sustainable soil and water management practices requires holistic approaches that integrate scientific knowledge, technological innovations, and community engagement. Policy frameworks must prioritize conservation efforts, incentivize sustainable practices, and enforce regulations to prevent overexploitation and pollution of soil and water resources. In conclusion, sustainable management of soil and water resources is imperative for safeguarding ecosystem integrity, ensuring food security, and mitigating the adverse impacts of climate change. By embracing innovative technologies, fostering collaborative partnerships, and implementing sound policies, society can transition towards a more sustainable future where soil and water resources thrive for generations to come.

Keywords: *Effective soil management, Sustainable practices, finite resource*

T4A-13

Sustainable Management of Soil and Water Resources: A Crucial Balance

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Abstract

Soil and water are fundamental resources for life on Earth, underpinning food production, healthy ecosystems, and human well-being. However, unsustainable practices threaten their quality and availability. This abstract explores the concept of sustainable management for these vital resources. Key concerns: Soil degradation due to erosion, salinization, and depletion of organic matter reduces fertility and agricultural productivity. Water scarcity arising from climate change, population growth, and overconsumption threatens irrigation, sanitation, and environmental health. Sustainable management strategies: Soil conservation techniques like cover cropping, reduced tillage, and contour farming minimize erosion and enhance organic matter. Water-saving irrigation methods like drip irrigation and precision agriculture optimize water use efficiency. Watershed management practices protect water sources and promote groundwater recharge. The benefits of sustainable management: Improved soil health leads to increased agricultural yields and food security. Efficient water use reduces pressure on freshwater resources and promotes environmental sustainability. Conclusion:

Sustainable management of soil and water resources requires a holistic approach that integrates social, economic, and environmental considerations. By adopting these practices, we can ensure the long-term health of these vital resources for future generations.

T4A-14

Rice Rhizosphere Microbiota under Different Nitrogen Application and Soil Moisture Regimes

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Abstract

Plant-microbe interactions at rhizosphere interface plays significant roles on plants nutrition and such interactions may be under tremendous influence by applied doses of inorganic nitrogenous fertilizers and availability of soil moisture. This study assessed whether applied low and high doses of inorganic N fertilizer under aerobic and submerged conditions alter the core microbiota community in the rhizosphere of scented rice. A control experiment was conducted under aerobic and submerged condition with four different treatments *viz*., Control (no application), Biofertilizer (CAU Bioenhancer), Low N (25 kg ha^{-1}) and High N (125 kg ha^{-1}) with five replications. Rhizospheric soil were collected and their bacterial community composition was analysed based on sequencing of the V3-V4 region of the 16S rRNA gene. Values of soil pH, organic carbon and availability of N, P and K, and readily soluble Al were significantly varied between treatment combinations. Growth and yield attributes such as plant height, number of effective tillers and grain and straw yield of rice were also greatly influenced by different soil moisture regimes. The diversity parameters of bacterial community among the treatments varied significantly. A total of 1059 OTUs were identified commonly under aerobic and submerged condition by 16S rRNA sequencing profiling, using a 97% of similarity against the database. 221 OTUs and 400 OTUs were obtained from aerobic and submerged conditions, respectively. Different treatments under submerged condition showed higher indices of richness and diversity estimators (Sobs, Chao, ACE, Shannon, Simpson, and Fisher). The dominant phylum detected were Planctomycetes, Bacteroidetes, Proteobacteria, Actinobacteria, Acidobacteria, Chloroflexi Fibrobacteres, Verrucomicrobia, Firmicutes, Gemmatimonadetes. The top 10 genus in the rhizosphere soil were *Planctomyces, Gemmata, T78, Nocardioides, Rhodoplanes, Candidatus, Solibacter, A17, Pirellula, Nostocoida and Clostridium* and the top 10 species in the rice rhizosphere soil were *Ruminofilibacter xylanolyticum, Gaiella occulta, Phaselicystis flava, Nostocoida limicola III, Clostridium ruminantium, Petrimonas sulfuriphila, Oryzihumus leptocrescens, Trachelomonas volvocinopsis, Roseomonas lacus.* Findings clearly demonstrated the differential influence

of high N fertilizer dose under aerobic and submerged conditions on the composition of the core microbiota of scented rice rhizopsphere.

Keywords: *16S rRNA, Core microbiota, Moisture Regimes, Rhizosphere, Rice*

T4A-15

Deficit irrigation strategies for enhancing productivity of French bean in mid hills of Meghalaya

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Abstract

French bean or Rajmash (*Phaseolus vulgaris* L.) is an annual herbaceous legume crop cultivated globally for food as dry seeds and fresh green pods. It is very nutritious and contains 22.9% protein, 1.2% fat, 60.6% carbohydrates, and a large quantity of minerals like Calcium, Phosphorus, and Iron. The North Eastern Hilly (NEH) region has a deficit of almost 82% of its pulse requirement despite having favorable agro-climatic conditions for pulse production. The rice and maize fallow areas have the potential for the cultivation of pulses like French bean to boost farmers' income as well as enhance their nutritional security. During rabi season, NEH region especially Meghalaya receives insignificant amount of rainfall and consequently, crops grown during this period experience moisture stress which is one of the reasons for low productivity. Under such water-limiting situations, deficit irrigation is one of the water management strategies where a given amount of water (less than required) is provided to meet the evapotranspiration (ET) demand of crop without compromising the potential yield. Hence, the yield response to water status is to be examined thoroughly, which leads to the development of crop water production functions. Considering the aforesaid scenario, an agronomic field trial was conducted in Split Plot Design with four levels of Available Soil Moisture Depletion (ASMD), viz., 20% (M1), 40% (M2), 60% (M3) and 80% (M4) level under main plot treatment and three French bean varieties, viz., Arka Arjun (V1), Arka Sharath (V2), and Zorin (V3), and replicated thrice. Highest seed yield was recorded for M1 (8.89 t ha-1) over M3 (5.76 t ha-1) and M4 (4.44 t ha-1). Among the varieties, highest yield was reported in V2 (10.05 t ha-1) over V1 (6.36 t ha-1) and V3 (4.17 t ha-1). Irrigation at 40% ASMD (M2) with variety Arka Sharath (V2) may be recommended for the farmer of NEH region for enhancing pulse production.

T4A-16

Soil and water resources and its sustainable management

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Abstract

Sustainable management of soil and water resources is crucial for ensuring long-term agricultural productivity, environmental health and human well-being. This review paper provides a comprehensive overview of the current state of knowledge on sustainable soil and water management, highlighting key challenges, strategies and future research directions. Soil health is a critical factor in sustainable agricultural production and ecosystem services. Healthy soils are characterized by a balance of physical, chemical and biological properties that enable them to function effectively as a living ecosystem. Sustainable soil management practices, such as cover cropping, reduced tillage and organic amendments, can improve soil health by enhancing soil structure, increasing organic matter content and promoting soil biodiversity. Water is considered the most critical resource for sustainable agricultural development worldwide. Sustainable water management in agriculture involves optimizing water use efficiency, reducing water pollution and adapting to climate change. Strategies include the use of water-efficient irrigation technologies, adoption of drought-tolerant crop varieties and implementation of water-saving practices. Integrated soil and water management approaches recognize the interdependence of these resources and aim to manage them holistically. This includes considering the impacts of soil management on water resources and vice versa. Collaboration among researchers, policymakers and practitioners is essential for developing and implementing effective strategies for sustainable soil and water management. While significant progress has been made, challenges remain in adapting to climate change, addressing competing demands for land and water resources, ensuring economic viability and improving knowledge and capacity. Future research should focus on developing innovative technologies, improving understanding of complex interactions between soil, water and climate and fostering interdisciplinary collaboration to support sustainable development.

T4A-17

Sustainable Management of Water Resources by Eco-dyeing Technique

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Abstract

Every sector of industry is shifting towards an eco-friendly alternative for achieving a sustainable and green environment. In the textile industry, eco-dyeing is a potential way to sustainable water resource management. Water, energy, and chemicals are frequently used in significant quantities during traditional dyeing procedures, which depletes resources and causes various pollution. Eco-dyeing techniques seek to achieve vivid, long-lasting colors while minimizing these detrimental effects. In this sense, the approach of eco-dyeing is increasing due to awareness of ecology, environment and pollution control in the textile sector. Natural dyes are derived from plants, invertebrates, or minerals, which do not contain any harmful chemicals that can pollute waterways and ecosystems. This makes them more environmentally friendly and minimizes the release of toxins into the environment. The study explains the eco-dyeing of cotton fabric using natural dye stuff extracted from pomegranate rind along with bio mordant myrobalan and banana pseudo stem sap. The different physical parameters of the dyed cotton fabric were evaluated. So the technique of eco-dyeing is very useful to maintain the sustainable management of water resources to produce high-quality and aesthetically pleasing textiles.

Keyword: *Sustainable management, eco-dyeing, cotton fabric, pomegranate rind, bio mordant*

T4A-18

Interlinkage of carbon credits and the sustainable development goals for sustainable agriculture

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Abstract

With global warming as the main obstacle, global climate change is turning into one of the most concerning issues of the twenty-first century. Since the Industrial Revolution, anthropogenic activities have significantly increased the amount of greenhouse gases (GHGs) in the atmosphere. Carbon credits, also known as carbon offsets, are a crucial instrument for reducing the consequences of climate change since they provide a means of offsetting greenhouse gas emissions and promoting sustainability. The market for emissions offsets is being driven by growing worldwide awareness of climate change, which signals well for the future of carbon credits. One element of national and international efforts to slow the rise in GHGs concentrations is the use of carbon credits. The right to emit one tonne of carbon dioxide or the mass of another greenhouse gas with an equivalent potential for global warming is represented by one carbon credit. They give a mechanism to minimize greenhouse gas emissions by giving them a monetary value. By encouraging sustainable agriculture, providing money for agricultural initiatives, encouraging reforestation, and addressing climate-related food insecurity, carbon credits can indirectly contribute to food security. These systems have the potential to improve crop yields, strengthen soil health, strengthen climate resilience, and aid rural people. In contrast, the Sustainable Development Goals (SDGs) comprise 17 interconnected global objectives that aim to serve as a "roadmap for realizing a more sustainable and better future for everybody." The 2030 Agenda, which includes the SDGs, was established by the UN General Assembly in 2015 with the goal of achieving them by 2030. The link between SDGs and carbon credit lies in the fact that many carbon credit projects contribute to achieving multiple SDGs. The Sustainable Development Goals (SDGs) 13 (Climate Action), 7 (Affordable and Clean Energy), 15 (Life on Land), 8 (Decent Work and Economic Growth), and 9 (Industry, Innovation, and Infrastructure) can all be furthered by the use of carbon credits. To fully realize this potential, though, a number of issues must be resolved, such as maintaining the credibility of carbon credits, avoiding duplicate counting, guaranteeing equity, and concurrently accomplishing numerous SDGs. Governments have the authority to establish the rules governing the carbon market and allocate funds from the sale of carbon credits to initiatives that advance the SDGs. People can encourage businesses and laws that advance the usage of carbon credits and the accomplishment of the SDGs. Thus, the SDGs and carbon credits provide a route forward for a sustainable future.

Key words: *Carbon credit, Global warming, Sustainable Development Goals, Food security*

T4A-19

Integrated Geospatial Analysis of Soil Organic Carbon and Rainfall Trends for Sustainable Agriculture in Nagaland, India

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Abstract

The overexploitation of natural resources is a pressing concern that demands immediate attention. To address this issue, it is crucial to estimate and observe natural resources swiftly. The development of geospatial technology has emerged as a pivotal tool for gathering information from targeted objectives. Among these natural resources, soil organic carbon (SOC) holds particular significance as it determines soil quality, fertility, agricultural profitability, and contributes to atmospheric carbon dioxide (CO2) fixation. Recent studies indicate that the many regions in Nagaland have maintained

stable SOC content over the years, areas such as Dimapur, Kohima, Mokokchung, and Wokha have experienced significant degradation. Rainfall, directly impacts agricultural production and the associated economy. However, the changing trend of rainfall has become a global concern. This study focuses on assessing the changing trend of rainfall in the state of Nagaland, utilizing the Innovative Trend Analysis (ITA) method. A 40-year dataset was analyzed using ITA, with the entire process automated through Python programming. out of the 11 stations considered, 3 stations indicated a rising trend, 8 indicated falling trends (annual), 4 rising and 7 falling (monsoon), 0 rising and 11 falling (winter). The extent of trend change varied from –34.5 to 1.1. Spatial distribution analysis highlighted that the South-East part of Nagaland experienced a more pronounced rising trend compared to the South-West. This trend was particularly evident during the winter season, followed by the pre-monsoon and monsoon periods. The findings underscore the significance of integrating technological advancements with environmental considerations to address the challenges posed by changing natural resource dynamics in a region dependent on agriculture for its livelihood and economic well-being.

Keywords: *Soil Organic Carbon, ITA, Rainfall, Agriculture, Climate, production, Sustainable*

T4A-20

Sustainable Management of Soil and Water Resources

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Abstract

Sustainable management of soil and water resources is very important for ensuring environmental resilience and human well-being. Soil serves as the foundation for a terrestrial ecosystem, supporting plant growth, nutrient cycling, and water filtration. However, unsustainable agricultural practices, urbanization, and industrial activities have led to soil degradation, erosion, and loss of fertility. This degradation not only threatens food security but also exacerbates water pollution and the loss of biodiversity. Effective soil management strategies, such as conservation tillage, crop rotation, and agroforestry, can enhance soil health, reduce erosion, and improve water retention capacity. Additionally,implementing sustainable water management practices is essential for mitigating water scarcity and pollution. This includes rainwater harvesting, efficient irrigation techniques, and wastewater treatment.Integrating soil and water conservation efforts into land-use planning and agricultural policies is crucial for promoting long term sustainability. Public awareness and education programs can also play a vital role in fostering responsible stewardship of soil and water resources.By prioritizing sustainable management practices, societies can safeguard vital ecosystems, preserve agricultural productivity, and ensure equitable access to clean water for future generations. Embracing a holistic approach to soil and water management is imperative for building resilient and thriving communities in harmony with nature.

T4A-21

Utilization of Renewable Energy Sources for Sustainable Soil and Water Management in Agriculture

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Abstract

The issue of food security needs to be addressed immediately as the global population is increasing. To solve this issue sustainable management of soil and water resources is crucial. However, the current agricultural methods that are being implemented generally lead to soil degradation, water depletion, and greenhouse gas emissions. Renewable energy technologies offer an alternative solution to tackle these challenges by providing clean, naturally available energy sources for agricultural applications. Integrating renewable energy sources such as biomass, wind and solar into agricultural practices can help in achieving the sustainable soil and agriculture goals. Solar energy can be used for irrigation purposes by using solar powered pump systems etc., This can minimize the energy costs and emissions related with groundwater pumping while also allowing precise water delivery to crop. Solar energy can also be utilized for generating electricity on farms, reducing dependance on energy generated from fossil fuel sources. Biomass derived from agriculture wastes, such as biochar and compost can improve soil fertility and water holding capacity of soil and increase the organic carbon present in the soil. Moreover, the agricultural residues and waste obtained can be used in biogas plants, which under anaerobic conditions produce biogas, a renewable fuel which can be used for various purposes such as cooking, heating and electricity generation also the slurry produced in the digester of the biogas plant can be used for increasing the soil fertility for improve crop yields. The utilization of renewable energy technologies will not only contribute to sustainable management of soil and water resources but will also help the agricultural sector move towards a circular, low carbon economy. This study aims to investigate the renewable energy sources and efficiently integrate them to achieve the objectives while also looking into the future challenges.

T4A-22

Development of microbial NPKZn biofertilizer consortium for use in acid soil

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Abstract

Scientific research has clearly established the role of microbes in crop growth and development. By altering soil microbes in rhizosphere, plant-microbe interaction has been found to be influenced, thereby increasing plant yield. Four identified bacterial isolates; Um-Azoto II, Um-PSB1, Um-KSB1, and Um-ZnSB1 were collected from the repository of the Microbial Ecology Lab., CPGS AS, CAU (Imphal), Umiam, Meghalaya. These pure culture isolates were screened for multifaceted PGP traits viz. production of IAA like substances, N_2 fixation, dissolution of zinc and potassium complex and dissolution of insoluble phosphate. All isolates showed IAA produce ability (ranged from 18.95 to 89.26 µg ml^{-1} h^{-1}). All four isolates possessed ability to dissolve $Ca_3(PO4)_2$ (ranged from 8.91 to 23.19 µg ml^{-1} h^{-1}). Only Um-ZnSB1 isolate can dissolve ZnO among others. Um-Azoto II and Um-PSB1 isolate were positive for N_2 fixation. Population of viable cells (cfu counts) of each of four PGPB isolates and in consortium recorded at 24 h, 48 h, 72 h, 80 days, 90 days and 120 days after incubation. All four isolates could maintain $>10^8$ cfu ml^{-1} broth till 90 days of storage. For comparative performance of biofertilizers on crop growth and yield, an field experiment was carried out at AICRP, IFS, ICAR-RC NEH region, Meghalaya. ARC potato crop were grown at 39 plots which contain 13 different treatments. T_{13} which has all four isolates in consortium mode contributed significantly for enhancing plant growth and tuber yield (6.33 tuber no. & 10.67 g tuber wt.), also has the potential to reduce plant physiological stress compared to rest of the treatments (3.33 to 5.33 tuber no. & 5.8 to 9.72 g tuber wt.). In conclusion, the NPKZn Biofertilizer formulation is recommended for higher productivity of ARC potato through multilocational field trials.

Keywords: *Bioinoculants; Dissolution of phosphate, potassium, and zinc complex; IAA production; N_2 fixation; Plant growth promoting traits*

T4A-23

Synergizing Agricultural Systems: Exploring Interdependencies in the Water-Energy-Food Nexus for Sustainable Futures

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Abstract

Scholarly literature and policy arenas increasingly embrace the water-energy-food (WEF) nexus as an innovative strategy for tackling intricate resource and developmental issues. This approach seeks to discern the interplay of water, energy, and food systems, while integrating social and environmental ramifications into decision-making processes, thereby shaping cross-sectoral policies. Despite the conceptual promise of the WEF nexus, its practical application in systematically assessing interconnections and facilitating the formulation of pertinent resource policies has remained limited. To address these constraints, the WEF Nexus (WEFN) framework emerges as a comprehensive solution. By prioritising optimal resource utilisation, bolstering resilience, and promoting sustainability within agricultural systems, WEFN provides a robust strategy for navigating these challenges. This study explores the synergies within agricultural systems in the context of the WEFN, aiming to provide a holistic understanding of current research, identify opportunities, and propose sustainable policy interventions. This study not only elucidates the diverse interconnections within the WEF nexus but also introduces three distinct conceptual frameworks: the interplay between WEF sectors, the intricacies of WEF interactions in agricultural production, and the untapped potential of the WEF nexus in agriculture. Furthermore, it underscores the imperative for future research to address gaps in understanding the WEF nexus, explore the interface between WEF and policy in agriculture, and enhance governance frameworks for managing the WEF nexus effectively.

Keywords: *Water-Energy-Food Nexus, WEF nexus in Agriculture, Policy, Sustainable, Development Goals, Conceptual Framework*

T4A-24

Integrated Approaches for Soil and Water Conservation in Agricultural Landscapes in the Hilly Areas of Northeastern India

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Abstract

Sustainable agriculture faces significant challenges due to soil erosion and water scarcity. This study explores integrated approaches for soil and water conservation tailored to this region's unique characteristics. Through surveys and community engagement, the effectiveness of terracing, contour farming, agroforestry, and water harvesting structures was assessed. These interventions aimed to reduce soil erosion and enhance water retention capacity. Results indicate significant reductions in soil erosion rates and improved water infiltration. Terracing and contour farming stabilized

slopes, minimizing runoff during heavy rainfall. Agroforestry systems enhanced soil fertility and water retention while providing additional income sources. Community participation was pivotal, fostering ownership and sustainability. Local farmers actively contributed to planning and implementation, facilitated by knowledge exchange sessions and capacity-building workshops. Challenges such as land tenure issues and resource constraints were identified, highlighting the importance of policy support and multi-stakeholder collaboration. In conclusion, integrated soil and water conservation measures offer promising solutions for sustainable agriculture in Northeastern India's hilly landscapes. By combining engineering solutions with ecological principles and community involvement, we can ensure food security and environmental resilience in the face of climate change.

T4A-25

Soil management practices vis-a-vis rhizospheric soil environment for increased crop production: A small step towards sustainable futuristic agriculture

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Abstract

High input, high output, low nutrient resource use efficiency and deteriorating environmental problems reflect the typical characteristics of the present intensive farming systems which ignores the biological potential of roots or rhizosphere for efficient mobilization and acquisition of soil nutrients. Root and rhizosphere research has been conducted for many decades, but the underlying strategy of root/rhizosphere processes and management in intensive cropping systems remain largely to be determined. Means to achieve synchronously high nutrient use efficiency as well as high crop productivity while maintaining the soil health has become a great challenge. The rhizospheric activity can be influenced by the holistic manipulation of various factors such as crop, soil, water as well as integrated management practices. Deka *et al*., 2020 reported that broadcasting seed in standing rice at 15 days after 50% flowering (relay cropping) recorded significantly higher grain yield, higher gross return and higher microbial activity in soil. The rhizospheric nutrient management (75% RDF+ vermicompost + PSB) can be a convenient approach for increasing grain yield of wheat (Kumar *et al*., 2020). Under field conditions, results demonstrated that in comparison with the optimized N application, conventional N supply (over-application) inhibits root growth at both the early growth stage and the rapid growing stage and cannot increase the final N content of the final grain as well as whole plant. The nutrient contents of soybean grains increased significantly in the integrated biofertilizer and NPK fertilizer treatments as compared to the sole application of biofertilizers (Ngosong *et al*., 2022). Kalidas-Singh and Thakuria, 2018 also reported that the maximum root volume and grain yield was simultaneously produced in SSP-root-dip+PSB+RP plots. Thus, those management practices which focusses on revival of rhizospheric soil plays a key role in improving crop growth and productivity and at the same time, contributes towards sustainability which is the greatest need of our future agricultural system.

Theme 5; Food and nutritional security- Crop-husbandry; Agro-forestry, Sericulture and Horticulture; Animal and aqua-based farming; Processing and value addition

T5A-1

Minor cereals for food and nutritional security in changing climate

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Abstract

Climate change is a burning issue within the last century and poises a continuous threat to lives, livelihoods and the earth's capacity to produce food. Climate-related extremes have affected the productivity of all agricultural and fishery sectors, with negative consequences for food security and livelihoods. For example, numerous threats of extreme temperature, cyclone and storm surge, inundation, salinity intrusion, and erratic rainfall with increasing intensity and frequency are originated from climactic variability, the major source of variation in crop production. The most critical impacts on agriculture such as soil degradation and unseasonal weather lead to unpredictable and unstable crop yields threatening food and nutritional security. Reduction in agricultural production induces grave hunger and malnutrition threats; in 2020, globally 462 million adults are underweight and around 45% of deaths among children fewer than 5 years of age are linked to under nutrition. On contrary, 1.9 billion adults and 38.9 million children were overweight or obese. A rise in sea levels due to global temperature increment threatens hundreds of millions of people in coastal communities and cities across the globe, increasing the incidence of communicable diseases such as malaria, dengue, and others. In the most extreme cases, hundreds of millions of people are likely to be forced to migrate from their homes by 2050. Minor cereals, viz. sorghum, oat, barley, and millets, are tangible food sources in many parts of the world, having high nutritive values. Minor cereals (and pseudo-cereals), the neglected and underutilized crops too, also possess wider adaptability to adverse climatic and edaphic factors, for example, high or low temperatures, water and nutrient stress

conditions, and others. New climate-smart agriculture/farming technologies e.g., climateresilient high-yielding cultivars for stress-tolerance, profitable location-specific cropping patterns, conservation agriculture, innovative cultural management to minimize yield gap, mechanization, etc., to be developed to bring unfavourable agro-ecosystems under productive sustainable agricultural practices.

Keywords: *Climate change, sustainable agriculture, Smart farming*

T5A-2

Integrated nutrient regimes on Precision aqua-farming for resource use efficiency and sustainability

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Abstract

An all-time record of 214 million tonnes in 2020 was recorded for global fisheries and aquaculture production. 87.5 million tonnes are being utilized as human food with a per capita consumption of 20.2 kg. Hi-tech aquaculture farming can improve the production efficiency through incorporation of technology in the farming system. Profits, quality and environment are the focus areas and production from a semi-intensive or intensive technology are prone to disease outbreak which can be controlled through better management practices and thus precision farming holds a promising approach towards better production and sustainability as well. Precision farming aids in the observation, measurement, and response to temporal and spatial variability, hence improving crop output sustainability. Precision farming frequently uses technology to automate farming processes, enhancing diagnosis, decision-making, and performance. The purpose of precision farming research is to define a decision support system for whole farm management that maximises input returns while conserving resources. Satellite farming makes farming easy with enhanced production by data acquisition from satellite and assess the remotely located farm. Cluster farming and cooperative farming helps the farming group of people to interact, exchange informations, innovations and ideas on inputs, outputs or technology incorporated in the farm for increase in production, better management practices with less impacts on the environment. Precision farming and its transfer of knowledge to the farmers can help in improving output sustainability.

Keywords: *Precision farming, innovations, sustainability, technology*

T5A-3

Conservation agriculture: A holistic approach towards food security in NEH region

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Abstract

Conservation agriculture is a resource conservation technology which involves minimum soil disturbance, permanent soil cover and crop diversification for achieving higher crop productivity. The rainfed monocropping system of farming in the North Eastern Region of India suffers from low productivity and possesses a greater threat of economic risk. This conventional agricultural practice leads to intensive natural resources mining and continuous degradation of soil, water, and vegetation. To maintain soil fertility and increase soil productivity to meet the food and nutritional security of the growing population, it is crucial to embrace sustainable methods.Conservation agriculture, particularly based on no-till systems, offers an alternative management system that overcome the challenges of climate change and increasing input costs. Studies conducted between 2006 and 2009 emphasize the importance of conservation tillage and residue management in various land situations. In terrace uplands, growing mustard solely on residual moisture after upland rice/maize is possible under conservation tillage, where crop residues, including weed biomass, are incorporated into the soil. Similarly, in valley uplands, growing a second crop of pea in rice fallow is feasible by retaining two-thirds or half of rice residues on the soil surface under zero tillage. Likewise, in valley uplands, cultivating a second crop of peas during the rice fallow period is possible by preserving two-thirds or half of the rice residues on the soil surface under zero tillage. They not only restore soil organic carbon (by 70.75%) and enhance biological activity (by 46.7%) but also conserve water and increase yields (by 49%) compared to conventional tillage.Therefore, adopting conservation tillage practices in terrace uplands, valley uplands, and low-land situations enables double cropping, improves farm income, and enhances livelihoods in rainfed Northeast India.

Keywords: *Sustainable agriculture, Conservation, Fallow land, Mono cropping*

T5A-4

Understanding the Nutritional Significance and Antioxidant-Mediated Antiaging Effects of Finger Millet

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Abstract

Aging is a multifaceted process that is associated with progressive, lethal, and unalterable changes like damage to different molecules (DNA, proteins, and lipids), cells, tissues, and organs which can be delayed by both genetic (Telomere shortening) and dietary interventions. It can be achieved by antiaging compounds of millets through modulation of different signalling pathways by acting on their molecular targets (mTOR, IIS, sirtuin). Finger millet is a source abundance high fibre, methionine, calcium, iron, polyphenols, and secondary metabolites, responsible for numerous potential health benefits. Antioxidant such as phenolics and flavonoids. It plays a major role in the reduction of lipid peroxidation, a process that plays a key role in cancer and aging. In this study mechanisms underlying deferment of aging and age-related diseases by phytochemicals of millets via affecting the processes like genetic repair, protein glycation, and stress responsive pathways are discussed.

Keywords: *Antiaging, Antioxidant, Finger millets, Phytochemicals, Telomere shortening*

T5A-5

Effect of combined application of novel bioformulations and chemical fertilizers on growth and yield of soybean under Manipur condition

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Abstract

Soybean is an important oilseed crop grown in northeast India and is flourishing well under the agroclimatic conditions of the region. The co-application of bioformulations with inorganic fertilizers enhances the growth and yield of the crop. So, an experiment was carried out at the CAU Research farm, Andro, Imphal during the *kharif* 2023 to evaluate the effect of conjunction of novel bioformulations *viz.*, Bio NPK & Bio Zn with RDF on soybean growth and yield. The experiment was conducted in a randomized block design with seven treatments replicated thrice. The seven treatments were T_1: Control; T_2: 100% Recommended dose of fertilizers (RDF); T_3: 75% RDF; T_4: 75% RDF + Bio-Zn; T_5: 75% RDF + Bio-NPK; T_6: 75% RDF + Bio-Zn + Bio-NPK; T_7: 75% RDF + *Rhizobium japonicum* + MDSR 14 + 12c (12c= *Burkholderia arboris*, High P solubilizing). The results have shown that the maximum yield (1564 kg/ha) was obtained in the treatment T_5: 75% RDF + Bio-NPK followed by T_6: 75% RDF + Bio-Zn + Bio-NPK (1504 kg/ha) which signifies that the yield improvement is possible with the conjoint application of biofertilizers and inorganic fertilizers. The maximum B:C ratio (1.95) was also found in T5: 75% RDF + Bio NPK.

Keywords: *Bioformulation, Soybean, Growth, Yield*

T5A-6

Effect of starter culture in enhancement of fermentation process of traditional fermented fish product of North East India Shidal

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Abstract

Shidal is a salt free and fermented fish product in which the shape of the fish remains almost intact. It is commonly consumed in all the seven Northeastern states (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura) of India, but most popular in the tribal belts and Bangla speaking communities of these states. For processing of *Shidal*, fish is fermented in specially designed earthen pots normally for 5–6 months where the semi-dried fishes are pressed tightly in the earthen pot and sealed air tight with cover paste. This restricts the production to only two batches per year. This has become the bottleneck for industrial production of most traditional fermented foods. Inoculation of starter culture is a common strategy to improve the quality of fermented foods & to accelerate its fermentation process. So in the present study *Lactiplantibacillus plantarum* was isolated and identified from traditional fermented shidal samples and used for inoculation as starter culture. Prior to inoculation the starter culture was characterized by performing different antimicrobial activity and probiotic characteristics against certain selected pathogens such as *Escherichia coli* (ATCC 25922), *Salmonella typhimurium* (ATCC 51812) and *Listeria monocytogenes* (ATCC 19115). The starter culture was inoculated at the rate of 10 ml/kg of 106cfu/ml *and* 105cfu/ml of *L. plantarum* cells. After inoculation, the effect of starter culture on rate of fermentation was evaluated by measuring the proximate, biochemical, microbiological and sensory qualities of the treated and control *Shidal* samples at an interval of 15 days for a period of 90 days. Based on the scores given by the panel of judge during sensory evaluation and estimation of other parameters, the best quality *Shidal* was obtained in 60 days of fermentation period. Overall, it can be interpreted from the present

findings that inoculation of *L. plantarum* as starter culture at two different concentrations accelerates the preparation process of *Shidal.*

T5A-7

Study of Fish Waste for its suitability for protein concentrate

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Abstract

Fish proteins are found in the flesh, head, fin, tail, skin and quts of the fish in varying quantities. Unutilized fish and fish processing waste can be used to produce fish protein concentrates which Contain amino acids and many bioactive peptides. After removing the fish flesh during the fish processing operation, all other parts are considered wastes which are not properly utilized. The aim of this study was to evaluate the different waste of fish (scales, gills, intestines etc.) for source of protein andto prepare protein concentrate. Extraction of protein was carried out in three phases with ethyl alcohol in the ratio of 1:2 mass by volume,agitated(20°C for 60 min,75°C for 90 min and 75°C for 75 min) and centrifuged for 20 min after each phase at 1000xg rpm.The fish extract was dried using hot air oven at 65°C to obtain solid extract. The dried solid protein extract was grounded in a grinder to get protein powder. Proximate analysis were done for raw fish waste, protein concentrate of gills &scales, intestines and all the waste together. The result shows that the protein concentrate of all the waste(gills, scales and intestines) gives the most desirable contents for protein,fats,ash and moisture for protein concentrate containing 63.209%,5.073%,1.83% and 10.045% respectively.According to Food and Agriculture Organization of United Nations, this concentrate falls under Type CEPC inich is a fish meal.

T5A-8

An overview on the potentiality of fish meal prepared from fish waste as a source of nutrition in aquaculture

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Abstract

A large amount of waste are being generated from fish during preparation of certain value added products. Instead of discarding these waste it can be reutilised for preparation of fishmeal which can be a good source of nutrition in aquaculture feed. Protein is an expensive component in fish feed and therefore it becomes crucial to determine the amount of protein required in different species and during the life stages of the culture period. A good quality fish meal contains 60 to 72% crude protein by weight. To promote optimal growth and health of farmed fish, especially when reared in high density systems (e.g., recirculating aquaculture), it becomes very important to provide the dietary protein and specific amino acid as required by the fish species. Proteins found in plant concentrates generally do not contain all the required amino acids and are deficient in essential amino acid like methionine. Fish meal include not only methionine, but also lysine which improves the growth and also provides resistant to numerous disease in animals. Mineral content ranges from 25 to 30% in fish meal. Fish meal prepared from whole fish are rich in calcium, phosphorous and magnesium due to the presence of bones. Riboflavin, niacin, pantothenic acid, choline, Vitamin B12, Vitamin A and Vitamin D are present in fish meal which supplies energy in fish and other animals. Moreover, the crude fibre present in fish meal is in lower amount which makes it suitable for proper digestion. For the production of fish meal, wet rendering process is commonly used throughout the world.The process of fish meal production involves the following steps, Raw material receiving, Cooking, Pressing, Fluffing, Drying, Cooling, Milling, Packaging, Labelling and Storage.

T5A-9

Enhancing Mithun rearing in Nagaland and Northeast India: Integrating technology for sustainable management

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Abstract

Mithun is an integral part of the cultural and economic fabric of northeastern hill states such as Nagaland, Arunachal Pradesh, Manipur, and Mizoram. Despite its socio-cultural significance, it faces multiple challenges in terms of population growth. The slow progress in population growth is attributed to various factors, notably difficulty in tracking and healthcare management, leading to economic losses and hindrances in rearing practices. The application of GPS tracking systems integrated with body temperature sensors to address these challenges. By utilizing GPS technology, we aim to facilitate the tracking and monitoring of Mithun, providing insights into their movement patterns and enabling efficient management practices. Furthermore, the incorporation of body temperature sensors enables the early detection of certain diseases, thus mitigating the health risks and economic losses associated with disease outbreaks. This technology-driven approach not only enhanced the efficiency and success of Mithun rearing but also encouraged broader

participation in Mithun husbandry activities. Ultimately, this integrated solution has the potential to contribute to the conservation and sustainable management of the Mithun populations in the region.

Keywords: *Mithun, GPS and temperature sensors*

T5A-10

Riverine fish resources of Tripura

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Abstract

The freshwater fishery resources of North East India comprises of rivers, reservoirs, lake, mini barrages charrars etc. The water resource can be broadly be classified into 3 categories viz., capture, culture-based, culture based capture fisheries resources. Out of total natural water area of North east India, reservoirs (39.83%) and rivers constitute (25.93%) respectively. Most of the water bodies are common property resources. Generally being the capture fishery people living along these resources are engaged in harvesting only. For this reason, productivity of reservoirs, rivers etc. in terms of species diversity and quantity declined significantly during the last two decades. one of the mega biodiversity countries & occupies the 9th position in terms of fresh water mega biodiversity (Mittermeier & Mittermeier, 1997). The North East region of India was identified as a biodiversity hotspot by the World Conservation Monitoring Centre (WCMC, 1998). In Tripura identified 124 fish species. So, a huge number of diversified fish in relation to their food & ornamental values. (FAB-COE,2018-2020). Among all the NE states as well as in India, Tripura is highest in consumption of fish. Therefore, with more than 95% of population being fish eaters, there is heavy demand for fish but a wide gap exists between supply and demand. More abundantly found Puntius sps followed by Barilius sps & Mystus sps and Channa sps. Puntius species are generally found in all the water areas (7.14%) followed by hill streams trout Barilius (5.1%). Total one hundred twenty four (124) species found in in Tripura. Gone through the previous record, it is found that other than one hundred twenty four species, more over fifty-four fish species have been recorded earlier by different authors.

Keywords: *River, Reservoir, Fish diversity, Tripura*

T5A-11

The influence of gel-formulated GnRH and domperidone on the reproductive function and stress physiology of Devario devario, an ornamental fish

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Abstract

Breeding of valuable ornamental fish is difficult in captivity due to habitat change and captive stress of fishes. To overcome this problem GnRH (Gonadotrophic Releasing Hormone) and domperidon are mainly used and those hormone accelerate previtellogenesis and vitellogenesis stages in fish so that early maturation of oocyte and oogenesis occur in fish irrespective of breeding season. Several methods are established for hormone administration. In this study to demonstrate the effect of dietary administration of GnRH and domperidone (DOM) on reproductive performance we conducted a 40 day- trial on Devario devario. In this regard, fish were fed with five experimental feed: 100µg GnRH and 50 mg DOM, 50µg GnRH and 25 mg DOM, 25µg GnRH and 12.5 mg DOM, 12.5µg GnRH and 6.25 mg DOM, and 0µg GnRH and 0 mg DOM per kg body weight of fish which were designated as T1, T2, T3, T4 and Control, respectively. Periodic sampling was done to understand the maturation indices like gonado-somatic index, fecundity, egg diameter, reproductive hormone, histological studies etc. and also blood parameters. At the end of the experiment we found, in female fish 50µg GnRH and 25 mg DOM per kg body weight shows better result whereas, 25µg GnRH and 12.5 mg DOM per kg body weight shows better result in male fish and also we concluded the experiment with successful breeding program.

Key words: *Ovatide®, gonado-somatic index, fecundity, egg diameter, Devario devario*

T5A-12

Fish to Bioplastics: Transforming Aquatic By-Products into Sustainable Materials

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Abstract

The increasing global demand for biodegradable plastics, coupled with the environmental concerns associated with conventional plastic production, has sparked interest in exploring alternative sources for bioplastic feedstocks. Fish waste, a byproduct of the seafood industry, presents a promising and underutilized resource for bioplastic production. With an emphasis on its abundance, renewability, and environmental advantages, this abstract describes the potential of fish waste as a resource for the synthesis of bioplastics. Fish waste contains an abundance of organic assets, including lipids, proteins, and chitin. This trash includes heads, scales, bones, and skins. There are several chemical and biological

processes that can be used to extract and convert these ingredients into biopolymers. Techniques such as enzymatic hydrolysis, microbial fermentation, and chemical treatments are used to transform fish waste into monomers that can be used in polymerization. Furthermore, improvements in biotechnological procedures have made it easier to separate and purify biopolymers from fish waste, increasing the viability of producing bioplastics on a wide scale. Desirable qualities including biodegradability, biocompatibility, and antibacterial qualities are displayed by the bioplastics that are produced from fish waste. Furthermore, using fish waste to produce bioplastics has a number of positive environmental effects, such as lowering waste and carbon footprints and opening up the possibility of closed-loop systems in the seafood sector. However, there are still issues with optimizing the bioplastics made from fish waste in terms of cost-effectiveness, scalability, and extraction efficiency. To address the various needs of industrial applications, more research is required to improve the mechanical and thermal properties of these bioplastics. Furthermore, it is important to pay attention to the ethical and sustainable aspects of procuring fish waste for the creation of bioplastics. As a sustainable substitute for traditional plastics, the review concludes by highlighting the potential of fish to bioplastics. The conversion of aquatic by-products into value-added materials offers a possible route towards a more sustainable and circular economy through interdisciplinary research spanning materials science, biotechnology, and waste management.

Keywords: *Aquatic by-products, Bioplastics, Circular economy, Eco-friendly materials, Fish waste, and marine resources*

T5A-13

Dietary and Therapeutic Benefits of Edible Insects

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Abstract

In recent times, the practice of eating insects (known as entomophagy) has gained significant global attention due to its perceived health benefits, as well as its positive impacts on the environment and economy. The challenge of achieving sustainable food security is currently a major concern worldwide. Edible insects offer substantial amounts of energy, protein, fatty acids, and essential nutrients for human consumption. The advantages of consuming insects include their efficient conversion of feed into edible mass, their ability to be reared using organic waste, thereby adding value to otherwise discarded materials and reducing environmental pollution. The nutritional composition of insects can be altered to meet specific dietary requirements. In regions where food scarcity is prevalent, incorporating edible insects into diets can help improve nutrition and prevent under-nourishment. Additionally, bioactive compounds found in insects might mitigate certain health risks. Concerns regarding the safety of consuming insect-based foods is generally low, primarily relating to potential allergenic reactions. Strategies to encourage the consumption of insect-based products involve highlighting their sustainability, enhancing their taste appeal, and incorporating insects into familiar food products. Due to their high nutritional value and calorie density, the consumption of edible insects has the potential to alleviate famine on a global scale. Their richness in quality protein, diverse micronutrients, and potential environmental and economic benefits position edible insects as a significant future food source worldwide. However, widespread acceptance among consumers, particularly in Western countries, remains a significant hurdle for adopting insects as a mainstream food sources.

Keywords: *Edible insects, Entomophagy, Edible mass, Sustainability, Insect*

T5A-14

The impact of edible coatings in prolonging fruit shelf life

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Abstract

It is necessary to develop strategies for prolonging the shelf life of fruits during storage because whole, minimally processed fruits spoils very quickly. The increasing demand for fresh, chemical-free commodities has focused a lot of attention on the use of non-chemical preserving techniques. One such method is the application of edible coatings, which involve applying a thin layer to the surface of fruit to act as a barrier between it and its surroundings while still allowing the fruit to be consumed as part of the whole product. Produce is protected from gases like O_2 and CO_2, water vapour, and fragrance compounds by the film that forms over its surface. Additionally, they alter the environment surrounding the product, reduce the rate of respiration and water loss, and maintain flavor and texture. Among other quality-improving attributes, they can also be used as carriers of nutrients, antimicrobials, texture enhancers, and anti-browning agents. Edible coatings can contain hydrocolloids (polysaccharides or proteins) and hydrophobic materials (lipids or waxes), or a combination of the two (composite coatings).The study illustrates the effects of edible coating on lemon fruits kept at room temperature stored in corrugated fibre box. Citrus fruits primarily experience weight loss due to transpiration, chilling injury, and ethanol production during postharvest storage. During the storage period, various

changes take place in the physical, biochemical, and sensory attributes. Therefore, edible coating can prolong the shelf life and reduce losses that occur after harvesting of the fruit.

T5A-15

Oil Palm- The Only Alternative for Mitigating Edible Oil Deficit in India

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Abstract

Oil Palm (*Elaeis guineensis*) can be traced back to more than 5000 years ago. In India oil Palm was introduced in 1960 for commercial cultivation in Kerela and in Andaman and Nicobar Islands during 1971 and 1975, respectively. Oil palm is recognized as the highest (4-6 tones/ha) and cheapest edible oil-yielding perennial crop. The crop is unique in producing two distinct types of oil *i.e.* palm oil and palm kernel oil, used for culinary and industrial purposes. At present, it is the largest source of vegetable oil in the world. Five countries mainly Indonesia, Malaysia, Nigeria, Thailand and Cambodia account for over 90% of the world's total production of Fresh Fruit Bunches (FFBs). Oil palm has established as a successful crop in a number of states in India and productivity levels of 4-6 tones oil per ha has been achieved by number of farmers. Production of palm oil in India continues to be at a meager level with respect to its actual requirement. Out of 26.7 million tons of total requirement of vegetable oils (2021-22), domestic availability was only 14.0 million tons, the remaining 12.7 million tons had to be imported from other countries. India is the largest importer of edible oil (15 per cent globally) and import values ranges at ₹66,000-1,41,000 crore. The Government has assessed that a total area of around 28 lakh hectares in the country and around 9.62 lakh hectares in the North East Region alone is fit for oil palm cultivation. Out of the total assessed area, only 3.69 lakh hectares is under oil palm cultivation including NE states at present, only of which 1.8 lakh ha is fruiting area. Hence there is a lot of potential for the growth of oil palm in the country. Recently, a new Centrally Sponsored Scheme namely, National Mission on Edible Oil (NMEO)-Oil Palm (NMEO-OP) has been launched by Government to promote oil palm cultivation for making the country Aatamnirbhar in edible oils with special focus on North Eastern States and A&N Islands. The north eastern states need to take up palm oil cultivation in a big way to reduce India's dependence on edible oil imports and to benefit the farmers in the region. So far only Mizoram has been promoting oil palm cultivation in an area of 26680 ha, while Arunachal Pradesh, Nagaland, Assam, Tripura and Manipur have recently evinced interest in this sector. The Mizoram government has brought together agro-industrial companies, multinationals and cooperatives to implement the scheme for cultivation of oil palm in the state. As growing annual crops under shifting cultivation is creating problems of forest fires and resulting in low yields, oil palm cultivation under such conditions can be advocated in the beginning and later it may be shifted to irrigated condition by developing proper irrigation facilities. It will also ensure socio-economic upliftment of the farmers of the region.

T5A-16

Bio-packaging used in Fish preservation in Sikkim

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Abstract

The traditional practice of making banana bio package from banana pseudo stem by some local fishermen and fish vendors for fish preservation is prevailing in the state of Sikkim. This study explores the use of banana pseudo stem as a bio packaging material for preservation, storage, and transportation of fish in Sikkim, presenting a sustainable and eco-friendly solution to the plastic non degradable packaging. The study was aimed to investigates the indigenous technical knowledge of fish farmers in Sikkim through surveys, revealing the traditional practice existing and the effectiveness of banana pseudo stem bio package in preventing spoilage, preserving fish quality and meeting consumer expectations. A survey has been conducted in different districts of Sikkim state to document the indigenous technology of the banana pseudo stem packaging for the purpose of fish transportation and preservation demonstrating its ability to maintain quality attributes effectively. Stakeholders acknowledge its user-friendliness, accessibility and eco-friendliness. Embracing banana pseudo stem packaging has the potential to boost the efficiency and sustainability of fish storage and transportation in Sikkim. This approach not only tackles environmental issues associated with traditional packaging materials but also encourages rural livelihoods by utilizing a locally available agricultural byproduct. It signifies a step towards environmentally amicable practices while fostering economic opportunities within the community.

Keywords: *Biopackaging, banana pseudo stem, economic opportunities, fish preservation, sustainability*

T5A-17

Unlocking opportunities: Rainbow trout farming a promising avenue for livelihood and employment in Northeast India's hilly temperate regions

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Abstract

Rainbow trout farming presents a promising opportunity in India's aquaculture sector, particularly in Himalayan regions with hilly terrains and temperate climates. States like Himachal Pradesh, Uttarakhand, Sikkim, Arunachal Pradesh, Jammu-Kashmir and Ladakh have emerged as leaders in rainbow trout production, leveraging their freshwater resources and favorable environmental conditions. In Meghalaya, despite its abundant water resources, the contribution to national fish production remains minimal. With vast riverine lengths and conducive environmental conditions, particularly for temperate species like trout, Meghalaya holds significant untapped potential. The initiative taken by young entrepreneurs in establishing Meghalaya's first private trout farm at Wahlyngkien Village, East Khasi Hills District marks a significant milestone in the region's aquaculture landscape. Commenced on June 6th, 2023, with the procurement of one-inch (0.5 g) rainbow trout fry from Shergaon, Arunachal Pradesh, and their stocking at the farm, this endeavor witnessed a culture period of 222 days, culminating in the first harvest on January 15th, 2024. Water was sourced from Lawkyntang into the culture raceways sized at 8.5 m x 3 m x 1.2 m (30.6 m^3), maintaining a stocking density of 16/m^3, and achieving a commendable survival rate of 72.2%. High-quality Nutrila-Growel feed, with CP ranging from 45-48%, facilitated remarkable growth, with a final average weight of 0.38 kg and SGR of 22.11 g day^{-1}. Efficiency indicators such as a FCR (0.96), FER (1.044), and PER (2.695) underscore the operational effectiveness of the venture. Financially, the capital investment for one unit of the specified raceway dimension amounted to ₹61,650, with operational costs totalling ₹38,300. Gross revenue generated stood at Rs. 1,00,240, yielding an impressive BCR (2.62) and revenue per unit volume (₹3275.81). This successful venture demonstrates the lucrative potential of rainbow trout farming in Meghalaya's hilly terrain, offering a promising avenue for enhancing rural livelihoods and contributing to the economic development of the region.

Keywords: *Aquaculture, Employment, Livelihood, Meghalaya, North-east India, Rainbow trout*

T5A-18

Assessment of Livelihood Security of Tribal Fish and Dairy Farming Community in Tripura

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Abstract

Indian economy is heavily reliant on agricultural activity, and a large part of the population still lives in rural regions, and farming is their main source of livelihood. The concentration of tribal people in rural areas is significantly higher, especially in mountain and forest zones. Tripura is a small state in the North Eastern region and the vast majority of tribal people (97.4%) live in rural regions of Tripura. Fish farming and the farming of cattle, pigs, poultry, and other livestock provide a source of income for the state's rural populations. The current study was carried out in Tripura in 2021 and 2022 to assess tribal farmers' access to livelihood security and diversification through fish and dairy farming. Purposive sampling was used to choose two districts for data collection (West Tripura and Khowai). A sample of 80 fish farmers and 80 dairy farmers was selected randomly from the selected districts, thus a total of 160 farmers were selected for primary data collection. Food security, Health security, Economic security, Social security, Education security, Institutional security, and Infrastructural security are the seven sub-indicators of livelihood security. The finding of the study indicated that infrastructural security is contributing maximum household livelihood security index for both fish and dairy farmers with values 0.415 and 0.385, respectively. While institutional security was contributing to the least livelihood security index value (0.025) for the fish farmers and social security contributed to the least livelihood security index value 0.044 for dairy farmers in this study area. The majority of Farmers had medium Livelihood Diversification, while a lower percentage had low 'Livelihood Diversification'. Other livestock like poultry, piggery, duck, and got farming was the main source of livelihood, followed by off-farm, fisheries, and dairy have been the most common livelihood for farmers. Livelihood security was discovered to be related to livelihood diversification. Diversification provides employment and alternative income-generating opportunities for fish and dairy farmers, while lack of skill and experience, inadequate skill training, and a decline in livestock productivity were major challenges affecting livelihood diversification.

Key words: *Livelihood security; Livelihood diversification; Fish farmers, Dairy farmers; Tripura*

T5A-19

Role and culture potential of tubifex in aquaculture

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Abstract

Microscopic powerhouses, Tubifex worms, boasting whopping 50-60% protein content (dry matter) and a healthy fat profile, are poised to revolutionize aquaculture's live feed landscape. Studies have shown remarkable results, with catfish larvae fed Tubifex exhibiting a tenfold increase in growth and significantly higher survival rates compared to those on formulated feeds. This translates to a potential game-changer for catfish hatchery and seed production. Beyond catfish, their size, rich nutrient profile, and ease of digestion make them a favorite food for ornamental fish. The ability to culture Tubifex using organic waste materials like dung or rice bran sludge (promoting sustainability and reducing reliance on commercially manufactured feeds) adds another layer of appeal. However, traditional live Tubifex come with concerns about parasite transmission. Research into closed-loop culturing systems with proper sanitation protocols alongside the development of various Tubifex products is key. Freeze-dried and flaked forms offer convenience and extended shelf life, while powdered Tubifex allows for precise control over nutrient profiles in formulated feeds. Live frozen Tubifex provides a safer alternative to traditional methods. By unlocking the full potential of Tubifex through research and innovative product development, the aquaculture industry can embrace a future powered by a versatile, sustainable, and nutritious live feed source.

Key words: *Tubifex, Ornamental fish, Fish hatchery, Live feed*

T5A-20

Diversity of stingless bee in mizoram and their importance in North East India

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Abstract

North East India is one of the hot spot for biodiversity in the world with diverse flora and fauna. The region is blessed with different species of stingless bee under genus *Lepidotrigona*, *Lophotrigona*, *Lisotrigona* and *Tetragonula*. Few tribal farmers used to practice Meliponiculture in this region since time immemorial however, the species diversity are not clearly known. There are about 9 species of stingless (one *Lepidotrigona*, one *Lophotrigona*, 6 *Tetragonula* and one *Lisotrigona*) described till date from North East region and many more are yet to be described. Since the diversity of stingless bee in Mizoram is not yet documented, the College of Horticulture, CAU, Thenzawl made an intensive collection of these bees from different places of Thenzawl area to study their diversity and its nesting characteristic. Our results show that there are 6 species of stingless bee under genus *Lepidotrigona* (3 species), *Tetragonula* (2 species) and *Lisotrigona* (1 species). The genus *Lepidotrigona* and *Tetragonula* used to make their hive in the tree trunk, rock crevices and concrete wall and one species of *Tetragonula* make their feral hive in underground soil however, the feral hive of *Lisotrigona* is yet to be found. Like other bees, all the stingless bee collect nectars and pollens from the flowers however, the genus *Lisotrigona* used to collect sweat and tears from human eyes. In Mizoram, Meliponiculture is not that much popular, but few pocket of farmers kept in wooden boxes and in original logs. The honey of stingless bee being one of the costliest and having highest medicinal valued; the NE India has vast scope for stingless bee honey production since the region has highest diversity of stingless bee compare to the other states in India. Therefore, there is a need to aware the farmers of NE India about Meliponiculture to double their incomes in future.

T5A-21

Exploitation of Nanomaterials as Post-Harvest Shelf Life Enhancer

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Abstract

The harvested fruits and vegetables are alive as they continue to respire oxygen and release carbon dioxide and heat. Consequently, many essential nutrients like lipids, proteins, organic acids and carbohydrates are metabolized during the process. This ultimately leads to deteriorating quality characteristics like colour, flavour, weight, nutritional value, and bioactive compounds of the harvested product. To minimize these losses, wax coating of perishable agricultural commodities has been practiced for a long back. But, wax materials are generally loaded with antimicrobial chemicals like Bavistin, Captafol, Potassium permanganate, etc. to increase their shelf life by decreasing pathogen attacks resulting some of the adverse effects on the human body. To overcome this, nanoparticle-enriched edible coated film product can be used to extend the shelf life of the harvested product owing to its durability, strength, and antibacterial and antifungal activities. Generally, GRAS chemicals -like nano-chitosan as well as metallic nanoparticles can be used as coating material for perishable commodities to extend their shelf life owing to their unique characteristics like moisture barrier, oxygen scavenges, ethylene scavengers and also to improved texture.

Keywords: *GRAS chemical, nanoparticles, shelf life, wax coating.*

T5A-22

Transforming Fisheries and Aquaculture: Harnessing Artificial Intelligence for Sustainable Growth

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Abstract

The application of artificial intelligence (AI) in fisheries and aquaculture has revolutionised the industry, offering solutions to pressing challenges such as depletion of aquaculture lands and aquatic pollution. Through AI-driven innovations like intelligent fish farms and smart cage aquaculture management systems, the industry is experiencing sustainable growth while maximising throughput in shorter time periods. This review explores recent advancements in AI implementation over the past half-decade, showcasing its role in transforming aquaculture into a less labor-intensive field with increased productivity. AI enables automation of tasks such as feed management, water quality control, harvesting, and processing, leading to significant efficiency gains. Additionally, AI facilitates the conservation of endangered aquatic species and promotes sustainability in open sea fisheries by tracking global fishing activity and combating illegal, unreported, and unregulated (IUU) fishing. In aquaculture, AI optimizes resource utilization, reducing input costs while providing complete control over fish production systems with minimal maintenance. By leveraging AI, aquaculture operations can enhance process efficiency, reduce energy and water losses, minimize labour costs, and improve disease management. The intuitive and inferential nature of modern AI systems, such as expert systems and neural networks, offers aquaculturists a powerful tool for implementing management systems that align with industry needs. As AI continues to evolve, its integration into fisheries and aquaculture holds immense potential for driving the industry towards greater sustainability, efficiency, and productivity.

T5A-23

India's Rice Production: A Comparative Analysis Using Neural Network Models

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Abstract

The world's most significant cereal crop, rice (Oryza sativa), provides food for almost one-third of the global population. About half of the world's population gets 30% to 70% of their daily calories from rice, making it a staple food in the Asian region. Here, the study employed two distinct neural network models to forecast India's rice production. It has been shown that for predicting rice production, the Multi-layer Perceptron Neural Network outperforms the Radial Basis Function in terms of accuracy. Compared to the Radial Basis Function (RBF) model, the Multi-layer Perceptron (MLP) model has a lower loss/error value. For MLP, a significant relative error is discovered.

T5A-24

Identification of potential sites for planting muga food plants in Biswanath, Assam using geo-spatial technology

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Abstract

Sericulture plays a significant role in economic development and poverty alleviation. The North Eastern region of India, specifically Assam is well-known for the cultivation of all the 4 types of silkworms *viz.* mulberry, eri, muga and tasar. Muga silkworm (*Antheraea assama*) is endemic to the state of Assam and it has got the Geographic Indicator (GI) in the year 2007. Muga silk is famous for the production of the yellow gold silk. The climatic and physiographic conditions of Assam create an ideal environment for the production of high-quality Muga silk products. The present study intends to focus on the expansion of muga host plants *viz.* Som, Sualu etc.in Biswanath district of Assam using geo-spatial technology. Climatic factors such as mean temperature & relative humidity derived from Worldclim data and physiographic factor such as elevation & slope derived from Carto-DEM. Culturable wastelands *viz.* scrublands (open & dense), grasslands and tree clad areas were delineated using multispectral satellite imagery of Sentinel-2 for the period of 2022-23. A multi-criteria analysis was carried out using Geographic Information System (GIS) software to identify potential areas for expansion of food plants of muga silkworms. The suitable areas were classified into 3 classes *viz.* highly suitable, moderately suitable and marginally suitable based on the distance from the village. Areas falling within 1 km from a village were classified as highly suitable. Areas falling within 1-2 km from a village were classified as moderately suitable and areas falling within 2-3 km from a village were classified as marginally suitable. An area of 35072 ha have been found to be suitable for expansion of muga food plants in Biswanath district of Assam out of which 30427 ha is highly suitable, 2304 ha is moderately suitable and 2340 ha is marginally suitable. The present study has demonstrated the utility of remote sensing and GIS have in identifying the potential sites for expansion of muga food plants in Biswanath district of Assam.

Keywords: *Culturable wastelands, Geographic Information System, muga food plants, multi-criteria analysis*

T5A-25

Faunistic and Diversity Study of Bamboo-shoot Fruit Fly in Ri-Bhoi District of Meghalaya Niladri B. Mohapatra[1*], Kennedy Ningthoujam[1], Jyotim Gogoi[1] and Kisan Rymbai[2]
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Abstract

Bamboo (Poaceae family) is a tall, arborescent grass which is called as 'Green gold' owing to its versatile uses, ecological significance etc. Meghalaya is richly endowed with varied bamboo species which is an important part of the livelihood and culture of the local tribal communities. Bamboo-shoot fruit flies caused extensive damage to the newly developed bamboo shoots, leading to oozing, stunted growth due to hollow internode and drying out the young sprouts. Some species are also destroying several apical internodes; as a result, it fell down to the ground. The extent of damage ranged from 35.27 to 55.42 %. Two groups of Tephritidae are known to be associated with bamboo in the oriental region: Gastrozonini (Dacinae) and Acanthonevrini (Phytalmiinae). In the Dacinae, only the tribe Gastrozonini has acquired bamboo as a host. Despite of existence of a huge biodiversity of bamboo-shoot fruit flies, limited information is available on the species composition of these flies in North East region of India. Therefore, to find out the species diversity of bamboo-shoot fruit fly and identifying various bamboo-shoot fruit flies. The present study was conducted from July2023 to April-2024 at four different bamboo forest area (Bhoirymbong, Umeit, Umtrew and Kyrdemkulai) in Ri-bhoi district of Meghalaya. A total number of 5 bamboo-shoot fruit flies i.e. Rioxoptilona dunlopi, Xanthorrachis annandalei, Acroceratitis bimacula, Acrotaeniostola spiralis and Acroceratitis ceratitina were collected from the study. Flies associated with different bamboo species were collected by two different methods i.e. Trapping and active searching. In trapping method, both male and female bamboo-shoot fruit flies of different species were collected by using two types of food baits i.e., ProteineX bait and Yeast bait. For active searching, the flies were collected by net sweeping as the adult flies are active during day time where young bamboo sprouts were present.

Keywords: *Bamboo-shoot fruit fly, Diversity, Meghalaya, Food bait, Gastrozonini.*

T5A-26

Vertical Farming: Tower/Column Aeroponics, the Future of Farming

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Abstract

Aeroponics farming is essentially growing of plants in an air or mist environment without using soil or water, is a modern solution to the modern problems. With increase in population increases the need for space, both, for construction as well as for agriculture requirements. Aeroponics is undoubtedly the way forward where farming could be made possible in the most uncertain of regions, be it densely populated cities or a rough hilly terrain, be it indoors or outdoors, fresh food is made available to everyone. Aeroponics not only makes farming possible in cities but can also help combat modern problems such as pollution, water scarcity. With tower Aeroponics we can save up to 80% of land space (hence reduced energy footprint), 95% of water requirement (as compared to traditional agricultural practices) and grow produce having about 45-50% more nutrient density, flavonoids contents and having much more antioxidant property thereby reducing the risk of pest and disease incidence which in-turn reduces the requirement of pesticides, further more such towers equipped with red light and ventilation could be used to grow our desired plant indoor as well. These towers are installed with 45watt submersible pump for 12 mins per hour (216 watts per month). These towers occupy an area of less than 10sqm, thereby 100 such tall tower i.e having 52 plants per tower could be accommodated in a space of 2000 square feet of area growing approximately about 5200 plants every 3 weeks (Variable depending upon the crop to be grown).Thereby Tower Aeroponics is assuredly the future and an apt solution to the 21st century farming issues.

T5A-27

Diversity studies of Banana (*Musa* sp.) local genotypes in Tripura and other North-Eastern parts of India and their prospects

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Abstract

Banana originated from South-East Asia with M. acuminata and M. balbisiana as its ancestral species. Though a great diversity has been observed for acuminata in Malaysia, Philippines, Indonesia and north- Eastern region of India, India harbours a greater diversity for balbisiana and acuminata-balbisiana bispecific clones (AB, AAB, ABB and BB/BBB). Tripura and other North-Eastern parts is considered to be the natural home of Banana and it is reservoir of many local genotypes. Due to favourable agro-climatic conditions, fertile and acidic soil with good depth and abundance rainfall favour the growing of various type of Banana and they are growing wild and semi-wild in the state. Diverse forms of Banana are growing in hills, slope and plain. In present studies, the different Banana (Musa) genotypes were collected from different places of North eastern region including Tripura and other North- Eastern and conserved in the field genebank at Department of Horticulture, College of Agriculture, Lembucherra, Tripura. Different local Banana genotypes namely Sabri, Martaman, Malbogh, Champa, Gopi-1, Gopi-2, Katch Kela-1, Katch Kela-2, Katch Kela-3, Tripura Cavendish, Kanai basi, Red banana, Monipur -1, Aitta kela-1, Aitta Kela-2, Bhimkol,Almora, Ornamental banana and Monohar Kela etc from different corners of Tripura and other north eastern states of India for dissecting the genetic diversity present in the banana genotypes of North eastern India. The available genotype were evaluated for plant characters like Plant height, pseudo-stem girth, number of leaf at flowering and harvest, leaf length and births, life cycle, yield. Bunch, fruit and bunch and finger characters like bunch weight, fruit length, number of hands/bunch, number of finger/bunch, number of hand/ bunch, number of finger/hand, fruit weight, fruit length, fruit diameter, fruit pulp weight, peel weight, TSS and other related characters have recorded. This study might help us to create a diverse gene pool collection in the Dept. of Horticulture, College of agriculture Tripura. Which could be used in different breeding aspects in future? The present study might help us to formulate different pre breeding studies for future developments.

Key words: *Banana, evaluation, genetic diversity, markers, Tripura and prospects*

T5A-28

Optimization of Ingredients and Processing Parameter For the Production of Selected Soy Health Foods

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Abstract

Soy products offer a considerable appeal for a growing segment of consumers with certain dietary and health concerns. A variety of soy products are available on the market with different flavours and textures and a low-fat, nutritionally balanced diet can be developed from them. It is quite evident that soy products do reduce the risks of developing various age-related chronic diseases and epidemiologic data strongly suggest that populations that regularly consume soy products have reduced incidence and prevalence of the aforementioned age-related conditions and diseases than populations that eat very little soy. The proximate composition of soy fortified products with comparision to their respective control samples revealed that the entire soybean fortified optimized products provided more protein than control sample. The protein content of soy fortified noodles were two times that of control sample. Addition of soy flour markedly increased fat content than control sample. Soy flour blended noodles recorded maximum fat of 8.37% in treatment T4 (20%) and minimum fat 4.58% in control sample. This article summarized the beneficial health, nutritional and functional properties of the soy ingredients and intends to illustrate the most current knowledge with a consciousness to motivate further research to optimize their favourable effects.

T5A-29

Can you design your own food?

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Abstract

Food design is at the forefront of innovation, shaping not only how we access and consume food but also our entire culinary experience. From genetic engineering to technological advancements, the landscape of food design is constantly evolving to meet the diverse needs and preferences of consumers. However, with these advancements come challenges, including ecological impacts and consumer acceptance. The evolution of food is deeply intertwined with human history and societal development. Genetic engineering and crop improvement processes have long been utilized to tailor food to human needs and desires, from traditional selection methods to modern genetic manipulation techniques. Innovations like Arctic® apples and Pinkglow™ pineapples showcase tailored traits in response to consumer preferences, while biofortification addresses nutrient deficiencies in staple crops. Concurrently, advancements in food-human interaction

design and technology expand the sensory experience of food beyond mere sustenance. For instance, the concept of EdiPulse aimed to design chocolate treats using a food printer. However, with these advancements come challenges, including ecological impacts and consumer acceptance as societal food neophobia, which impedes acceptance of novel foods. Despite these hurdles, our relationship with food continues to transform, reflecting a broader shift towards viewing food as integral to human experience and culture. Ongoing scientific and technological progress continues to shape a future where food is not just for sustenance but a holistic and multisensory experience.

Keywords: *genetic engineering, crop improvement, consumer preferences, food-human interaction, food neophobia*

T5A-30

Unravelling the Nutritional Composition of Na.kam su.a: A Traditional Fermented Fish Product of the Garo Tribe in Meghalaya

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Abstract

Traditional fermented fish products have been an integral part of the cuisine and culinary practices of various ethnic communities across Southeast Asia. One such unique product is Na.kam su.a, also known as Kutung in Khasi language, which is predominantly prepared by the Garo tribe of Meghalaya, a state in northeastern India. This fermented fish delicacy is made from the Gangetic hairfin anchovy (Setipinna phasa), a small fish species found in the region. Fermented fish products are rich in various beneficial nutrients, including amino acids, nitrogen, and several trace elements such as sodium chloride, phosphorus, calcium, and fluoride. As a result, they serve as natural taste enhancers and provide a valuable source of essential nutrients in traditional diets. Na.kam su.a is a prime example of this culinary tradition, reflecting the Garo tribe's deep connection with their natural surroundings and their innovative use of locally available resources in the preparation. The fermentation process employed not only enhances the flavor but also contributes to the product's unique aroma and low rancidity. The study aimed to investigate the proximate composition of Na.kam su.a, providing valuable insights into its nutritional profile. The analysis revealed that this fermented fish product contains an impressive 31.34% crude protein, making it a significant source of high-quality protein in the local diet. Additionally, it was found to have a moisture content of 34.12%, ash content of 17.16%, and a lipid content of 11.44%. This study highlights the importance of traditional fermented fish products in the culinary legacy and dietary patterns of indigenous communities. By delving into their nutritional composition, these products can aid in conserving and promoting these cultural practices, while also exploring their potential for broader applications in the food industry.

Keywords: *Fermented fish; proximate composition; Traditional fish product; Garo tribe; Ethnic culinary heritage*

T5A-31

Food and nutritional security -Animal and aqua-based farming

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Abstract

Food and nutritional security are critical goals for sustainable development, especially in regions like Northeast India, where diverse cultures, challenging terrains, and variable climatic conditions influence agricultural practices. Animal and aquaculture-based farming offer significant potential to enhance food security and nutrition in this region. This abstract explores the role of animal husbandry and aquaculture in supporting food and nutritional security in Northeast India, considering both the challenges and the opportunities. Northeast India is known for its rich biodiversity and abundant water resources, providing a conducive environment for animal and aqua-based farming. Livestock farming, including cattle, poultry, and pigs, plays a central role in meeting the protein needs of local populations, contributing to dietary diversity, and supporting local economies. Aquaculture, especially fish farming, is also gaining momentum, with fish being a staple in many local diets. Integrated fish farming is a sustainable practice that enhances food production without additional land use. Despite the potential, several challenges like inadequate infrastructure, limited access to markets, and traditional farming practices that may not align with modern sustainability goals. Additionally, climate change and environmental degradation pose significant threats to these systems hinder the full realization of food and nutritional security through animal and aqua-based farming in Northeast region. To address these challenges, there is a need for targeted policy interventions and community-based approaches. Training and capacity-building programs can help local farmers adopt modern techniques, while infrastructure development can improve market access. Animal and aqua-based farming offer viable pathways to achieve food and nutritional security in Northeast region.

T5A-32

Evaluation of Kuroiler chicken (FFG strain) for its growth performance in Ri Bhoi District of Meghalaya

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Abstract

Kuroiler, FFG strain is a genetically improved chicken variety developed by crossing coloured Broiler males with Rhode Island Red Female. It attains a market weight of 1 kg at -5-6 weeks of age and has a commercial value for small and marginal farmers in rural areas of Meghalaya. The present study was conducted at College of Agriculture, CAU(I), Kyrdemkulai, Meghalaya under Experiential Learning Programme (ELP). The growth performance of Kuroiler FFG chicken in Ri Bhoi district of Meghalaya under tropical weather conditions was evaluated. A total of 50 birds were used for this study and were reared under deep litter system, fed with basal diet formulated for starter (0-3 weeks) and finisher (4-8 weeks) and other management practices like debeaking, deworming, vaccination, addition of vitamin and mineral supplements, litter management were carried out. The average body weight gain of 50 birds at 8 weeks, total feed intake upto 8 weeks of age, Feed Conversion Ratio (FCR) and Dressing Percentage was recorded. The results showed that, an average of 2.2 to 2.4 kgs of body weight was attained by a bird at 8 weeks of age; 4.0 kgs of feed consumed by a bird upto 8 weeks of age; FCR 1.6-1.8 and the dressing percentage was 72-75% which is highly equivalent to the commercial broiler chicken. Thus Kuroiler FFG chicken performs better than broiler chicken with 0% mortality rate and are highly suitable for backyard rearing being advantageous over the other. The net profit generated during the 8 weeks duration was Rs. 15,000/-, proving that Kuroiler FFG chicken rearing and marketing would be a profitable, sustainable business model which not only improve the livelihood and nutritional security of tribal(women) farmers but also increase/double the income of farm families of Ri Bhoi district, Meghalaya.

T5A-33

Study on Drying Characteristics of Green Banana Slices

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Abstract

Food is a substance that organism consume to supply energy, nutrients, and nourishment for growth and maintenance of bodily function. However, food cannot remain fresh for an extended period of time, even if it is fresh. Therefore, Food preparation is necessary. Food preparation methods refer to the various techniques and processes involved in transforming raw ingredients into cooked or ready-to-eat dishes. The food's flavor, texture, taste, appearance, and nutritional content can be significantly affected by this technique. Well, one of the food preparation techniques is preservation. Preservation is a process to extend shelf life of food. Some of the techniques under preservation are canning, freezing, drying, sugar curing. pickling, or fermenting. Specifically, we are choosing drying out of all these methods since it is a popular technique for moisture removal and preservation of food materials. The major goal of drying in the food sector is to protect and prolong the product's shelf life. The main aim of this work is to evaluate "Drying Characteristics of Green Banana Slices" at different temperature domain to find an optimum and energy efficient processing condition. Fresh Green Banana was cut into thin slices. The samples were blanched in hot water and the initial moisture content was determined. Banana slices were dried by convection drying using tray dryer at 50°C, 60°C, 70°C. The sample were drawn at regular interval and the weight changes were noted. Drying was carried out until there was no change in weight with the drying time. The dry basis M.C. was plotted against time, rate of moisture content change against time, moisture ratio against time and ln(MR) against time and ln(MR) against t/L2 graph was plotted

T5A-34

Can animal and aqua-based farming be an alternative to solve the food and nutrition security in North East India?

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Abstract

Northeast India, known for its diverse agro-climatic conditions and rich biodiversity, faces significant challenges in ensuring food and nutritional security across the region due to factors like geographical isolation, limited arable land and socio-economic inequality. This article tries to explore the critical role of animal and aqua-based farming in addressing these challenges across the region. Animal husbandry or animal-based farming including poultry, dairy and other small ruminant farming, offers a sustainable source of protein, essential nutrients and also ensuring income diversification for rural households. Additionally, animal husbandry contributes to soil fertility of the region through manure production enhancing the agricultural productivity. Aquaculture or aqua-based farming, particularly freshwater fish farming thrives well in the region's abundant water resources. It not only provide nutritious food but also generate employment opportunities contributing to poverty alleviation in the region. Additionally, aquaculture can help reduce the region's dependency on imported seafood. Furthermore, integrated fish farming systems with agriculture offers synergistic benefits such as nutrient recycling and enhanced productivity. By leveraging the region's natural resources and

traditional knowledge systems, animal and aqua-based farming can contribute significantly in improving the food and nutritional security in Northeast India. These sectors can contribute significantly to the well-being of the region populace and foster sustainable development.

Keywords: *Ruminant, soil fertility, integrated fish farming, agriculture, nutrient recycling, food and nutritional security, sustainable development*

T5A-35

Watermeal (*Wolffia globosa*): Exploring its Potential as a Source of Bioactive Compounds for Future Food Applications

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Abstract

Wolffia globosa, commonly known as Asian watermeal or duckweed, is a tiny aquatic plant that shows significant promise as a source of bioactive compounds with diverse applications in the food industry. Its small size, rapid growth rate, and nutrient-rich composition make Wolffia globosa an attractive candidate for sustainable food and feed resources. This versatile plant holds potential not only as a nutritious source of fish feed ingredient but also as a valuable source for human consumption. Cultivating wolffia requires minimal resources and can be environmentally friendly, aligning well with the increasing demand for sustainable food sources. Wolffia is particularly noteworthy for its high protein content, minerals, and bioactive compounds, including phenolic compounds, flavonoids, carotenoids, and alkaloids. These bioactive compounds offer unique nutritional benefits and functional properties that could enhance the quality and nutritional profile of food products. Moreover, they exhibit various bioactivities such as antidiabetic, anti-inflammatory, anti-cancerous, and antioxidant properties. These qualities make it a promising option for addressing food security challenges and promoting sustainable aquaculture practices.

Keywords: *Wolffia, Phenolic compounds, flavonoids compounds, bioactivity, fish feed, future food*

T5A-36

Food processing in achieving food and nutrition security

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Abstract

Food and nutrition security continue to be important issues on a worldwide scale, affecting various health consequences as well as nutritional status. The World Food Summit of 1996 defined food security as existing "when all people at all times have access to sufficient, safe, nutritious, food to maintain a healthy and active life". Nutrition security demands the intake of a wide range of foods that provide the essential needed nutrients like protein, energy, vitamins and minerals that are required for growth and development. The WHO and FAO depict food security consists of these four dimensions viz."food availability", "food access","food use" and "stability". Food and nutrition security are closely related since only a food-based strategy can effectively combat malnutrition in a way that is both socially and economically viable and is key to attaining the Sustainable Development Goals and other goals of the nation. Food processing encompasses a wide range of methods and approaches utilizing many technological platforms like thermal treatments, mechanical treatments, fermentative treatments, and the addition of culinary ingredients. Food processing prolongs food shelf life, maximizes food quality and nutritional availability, and minimizes loss and waste. It often increases food "availability" by extending food preservation over time, space, and seasons, allowing food to be provided in sufficient quantities to the largest number of people on the planet. It makes "access" easier, especially in large megacities, and more affordable, especially for disadvantaged people and organizations. It helps ensure that food is "stable" in the face of cyclical or abrupt shocks by enabling the preservation and global storage of vast amounts of food. Thus, food processing has a critical role in achieving food and nutrition security.

T5A-37

Aqua-based farming systems for food and nutritional security in North East India

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Abstract

The northeastern region of India is endowed with rich fishery resources, making it the 6th among the top 25 biodiversity hotspots globally. In India's Northeast (NE) region, the fisheries sector holds significant socio-economic and cultural importance for the local communities. Despite its immense potential, the fish production in this region remains largely untapped. The NE states of India possess extensive water bodies suitable for fish production, totalling approximately 5.63 lakh hectares of water spread area. This includes reservoirs, tanks, ponds, floodplains, and derelict water bodies. Arunachal Pradesh stands out with the largest water spread area of 3.18 lakh hectares, followed by Assam with 1.35 lakh

hectares. Additionally, the region boasts 20,875 kilometres of riverine resources, with Meghalaya, Assam, and Manipur having significant lengths of rivers. The abundance of water resources presents a vast opportunity for enhancing fish production and promoting aquaculture activities in the region. Aqua-based farming systems hold significant potential for addressing food and nutritional security in North East India. The region's abundant water resources, including rivers, lakes, and ponds provide an ideal environment for aquaculture development. Implementing aqua-based farming systems, tailored to the region's unique characteristics, can enhance food production, improve nutrition, and create livelihood opportunities for local communities. Recreational fisheries, as a component of aqua-based farming systems, have also the potential to generate significant livelihood opportunities while contributing to the overall socio-economic development of communities. Proper utilization of these resources, coupled with sustainable management practices and technological interventions, can significantly contribute to the sustainable development of the NE states. Furthermore, strategic investments and policy support aimed at harnessing the region's fishery potential can lead to improved livelihoods, food security, and cultural preservation for the local communities.

Keywords: *Aqua-based Farming, Livelihoods, Socioeconomics, Recreational Fisheries, Local Communities*

T5A-38

Integrated aquaponics cum poultry system for sustainable resource management in North-East Bharat agriculture

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Abstract

This project mainly focuses on the sustainable management as well as the best integrated way of farming for the people belonging to northeast region of Bharat. As most of the Northeastern states receive monsoon twice a year, there is plenty resource of fresh water. People can implement this integrated farming system to enhance their farm profit in the most suitable way without harming the environment. Small ponds can be built in the farm (if possible shallow ponds). Then poultry unit have to be constructed on the corners of pond shore. Surrounding the poultry unit, floating bases for hydroponics planting system is installed. Hydroponic is a system of growing plants in water without soil. Aquaponics is a system where the nutrient rich water of aquaculture is fed to the hydroponically grown plants. In the system of aquaponics, the water has to be provided with extra supplementary fed for fish production. So, if we integrate poultry system in this aquaponics, the dropping(excreta) of birds will be sufficient for fish feed production as well as there is cost cut in pond fertilization. The fish excreta will be sufficient source of nutrients for the growth of plants, in exchange the plants will purify the water. As it is based on the natural conditions and with the most basic ideas, it can be implemented by all type of farmers with their basic knowledge on agriculture.

Keywords: *Sustainable, integrated farming, hydroponics, aquaponics, poultry*

T5A-39

Exploring indigenous Citrus germplasm with innate resistance against citrus canker in Northeastern India

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Abstract

Citrus canker is a highly contagious bacterial disease caused by *Xanthomonas citri* subsp. *citri*, poses a significant threat to global citrus production by causing characteristic symptoms of leaf spots, stem cankers, raised lesions on both the leaves and fruit, and it can also result in the dropping of leaves and fruit. The main objective our investigation was to identify unexplored indigenous citrus germplasm that exhibits natural resistance against citrus canker. A comprehensive Screening and assessment of thirty distinct local citrus germplasm were conducted, subjecting them to controlled artificial inoculation with the citrus canker pathogen and establishing a relationship between defence-associated secondary metabolites present in citrus plants and the extent of disease resistance. The study revealed significant differences among the tested germplasms in terms of disease resistance and severity. Of thirty evaluated germplasm, eight exhibited resistance (R) response, out of which, wild germplasm Jora tenga exhibited the lowest disease severity of 14.67%. Thirteen germplasm displayed a moderate degree of susceptibility (MS), seven germplasms were categorized as susceptible (S) types and among the evaluated citrus germplasms, the Assam lemon demonstrated the highest level of susceptibility (HS) to citrus canker, with disease severity of 78.14%. In further analysis of secondary metabolites, the study revealed significant variations in total phenol, flavonoid, and alkaloid content among citrus leaves, depending on the germplasm. The germplasm Latipes, Jora tenga, and Adajamir, which exhibited resistance (R) to citrus canker, demonstrated the highest levels of total phenol content (21.26 mg/g dry weight), flavonoids (6.47 mg/g dry weight), and alkaloids (10.52%), respectively. Our findings revealed a negative correlation between the levels of secondary metabolites and the establishment and severity of the disease.

Keywords: *Citrus canker, screening, resistance, secondary metabolites*

T5A-40

Millets -A Systematic Literature Review on its role in Evergreen Revolution

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Abstract

Millets are one of the oldest farmed cereal grains in the world and are believed to be the first domesticated cereal grain. Some of the main varieties of millet are sorghum(jowar), pearl millet(bajra), finger millet (ragi or nachni), brown top (sama), kodu (arke), proso (chena/barr), barnyard (sanwa) and foxtail millet (kora). Millets are group of small grained cereal food crops which are highly nutritious and are grown under marginal/low fertile soils with very low inputs such as fertilizers and pesticides. Millets are high in protein, fiber, essential vitamins, and minerals, especially minor millets have very rich nutrients and minerals and resistant to drought and stress in rainfed farming. Millets are renowned as a nutritional powerhouse. It aids with immunity, weight reduction, and overall health. After the Green revolution rice production doubled and wheat production tripled. This change dropped the millet share in food grain production from 40% to 20%, leading to some serious agricultural, environmental, and nutritional consequences (S & V millet). In case of minor millet almost eight-fold reduction in area decreased from 53.35 lakh ha in 1955-56 to 6.82 lakh ha in 2013-14 at India level (P. Anbukkani et.al.). Total small millet production in Meghalaya in 2012-13 was 760 MT, in 2017-18 was 721 MT and the area under small millet cultivation was 1277(2012-13) and 1108(2017-18). (Abdul K Azad et.al.). India designated 2018 the "National Year of Millets" in order to encourage the production and consumption of millets or nutri-cereals. Millet's production climbed from 14.52 million tons in 2015-2016 to 17.96 million tons in 2020-21(Sharmila Oshwal et.al.). The United Nations General Assembly has declared 2023 as the "International Year of Millets!" After being proposed by India, the idea was supported by over 70 nations in an effort to educate the world about the nutritional and ecological benefits of millets and to encourage governments to facilitate millet production and consumption.

Key Words: *Millet, Sustainable Development, Nutrition*

T5A-41

Raised and sunken bed system for achieving food and nutritional security under low lying paddy fields of North Eastern Region

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Abstract

The north-eastern region (NER) of India faces challenges in diversified cropping systems due to its abundant rainfall and sub-tropical climate. The valley land ecosystems of this region face unique challenges such as waterlogging, poor drainage, and limited crop cultivation options beyond the rainy season rice harvest. This necessitates the development of alternative technology for low-lying paddy lands to explore the challenges associated with conventional farming practices i.e., low cropping intensity, poor soil health, and limited income opportunities. Innovative land configuration techniques, such as raised beds and sunken beds (RSB), offer opportunities for year-round crop production, efficient water management, and improved resource utilization. Over 65% of the valley ecosystem remains fallow after rice harvest, offering potential for other crops like pulses, oilseeds, and vegetables. Under RSB system, diversification of cropping systems is feasible, with options like rice-lentil and rice-pea combinations in sunken beds, alongside various vegetable combinations such as tomato–brinjal–broccoli and tomato–okra–broccoli on raised beds. Introducing crop diversification can improve agricultural systems' resilience, increase employment generation, and enhance soil health. This system can be used for a minimum of 5-6 years with optimal care, enhancing cropping intensity up to 300% in raised beds and 200% in sunken beds, respectively. The adoption of RSB technology brings about significant improvements in water use efficiency and water productivity, with potential gains up to 3-4 times higher compared to traditional rice mono-cropping practices. RSB system is efficient in increasing the yield by more than 8 – 10 times and generating employment by 4-5 times. Hence, this system adoption for low lying paddy lands contribute to sustainable development goals towards achieving food and nutritional security alongside livelihood development.

Keywords: *Raised & sunken bed, crop diversification, livelihood generation, sustainable development goals*

T5A-42

Agroforestry: A Sustainable Pathway for Carbon Trading and Climate Change Mitigation

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Abstract

The pressing challenge of climate change, exacerbated by escalating greenhouse gas emissions, necessitates innovative solutions. Carbon trading, a market-oriented approach aimed at curtailing greenhouse gas emissions, especially carbon dioxide from fossil fuel combustion, has emerged as a crucial strategy. With global temperatures rising and climate-related disruptions intensifying, as highlighted by the IPCC 2022 report, urgent action is imperative to prevent millions

from falling into extreme poverty. Within the framework of initiatives like REDD+, agroforestry assumes significance as a means of carbon sequestration, offering a pathway to mitigate climate change. By integrating agroforestry practices into farming, even on a small scale, substantial amounts of carbon can be sequestered, thereby bolstering carbon trading efforts and advancing climate mitigation objectives. Additionally, the adoption of agroforestry systems not only enhances agricultural productivity but also contributes to ecosystem stability and biodiversity preservation. Through such integrated approaches, farmers can diversify their income streams by trading carbon credits alongside traditional agricultural and forestry products. Hence, the adoption of diverse agroforestry systems holds promise not only for mitigating climate change but also for enhancing the livelihoods of farmers.

Keywords: *Agroforestry, Carbon trading, Carbon sequestration, Climate change*

T5A-43

Dynamics of boron phasing on yield, uptakes and boron fractions in rice-rapeseed cropping system in Typic Haplaquepts soil of Manipur

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Abstract

Boron is a micronutrient critical to the growth and health of all crops. Boron deficiency is becoming a concern especially in low land rice production systems. Boron nutrition can potentially enhance the yield quality and nutritional uptake patterns of rice crop tremendously. The primacy of boron outpace to a limiting factor in productivity of rice cultivation. It is pre-requisite to be aware of the rate and frequency of B application for conventional production of rice cropping system. A three years field trial has been conducted to evaluate the potential of boron nutrition in low land rice at different dose and at various frequency of application. The treatments were allocated @0.5, 1.0, 1.5, 2.0 and 2.5 kg B/ha at different interval of once in a year, alternate and continuous in three year. From the experiment, it was found that continuous boron application @1.5 kg/ha for three years produced highest yield of rice while application of 1.5 kg/ha of boron in alternate year produce remarkable result among the treatments. The residual impact of boron persists till the next succeeding crop and exhibited similar yield patterns. The content of different boron fraction improved with the increased in rate of boron application. The percentage contribution of various boron fractions towards total boron content follows the order: readily soluble boron (1.02 to 1.32%) <specifically adsorbed B(1.91 to 2.78%) <oxide bound B(4.97 to 6.94 %)< organically bound B (10.92 to 15.37%) < residual B(74.03 to 80.61%) respectively. However the uptake pattern of boron takes a sharp turn which show greater uptake of boron as doses of boron goes on increasing. The highest boron uptakes in rice were recorded in 2.0 kg/ha of boron in continuous application of boron in all three year. The uptake pattern of showed a succeeding trend which marked the greater effect of boron nutrition in low land rice cultivation in Manipur.

Keywords: *Boron, dynamics, yield, uptake and fractions*

T5A-44

Indigenous Practice of Processing and Value Addition in Fish in NEH Region-Economic Prospects and Issues

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Abstract

North East India is characterized by a diverse population of people with different ethnic background. In Northeast region of India, smoking of fish and fermentation are age old economical methods for processing and preserving food. In addition to preservation, fermented foods can also have added benefits of enhancing flavor, increasing digestibility, improving nutritional and pharmacological values (Khogen *et al*). Fish smoking prolongs the shelf-life of the fish, enhances flavor, increases utilization of the fish, reduces waste and increases protein availability to the people. In this study economics and marketing of indigenous value added fish products such as Matka shidal and smoked fish in Tripura and Manipur has been analysed using primary data. The processing of *Shidal* involved several activities like procurement of dry fish (Puntius sp), sorting and cleaning of dry fishes, preparation of matka (earthen pot) with mustard oil and airtight packing and keeping it for 6 months for the fermentation. Similarly, smoked fish are one of the popular and highly consumers' preferred products in Manipur. In Tripura two varieties of *shidal* namely *puti shidal* and *bashpati shidal* are processed and average cost of processing of *puti* and *bashpati shidal* were Rs. 213647.5/t and Rs. 171728/t, respectively. The processors earned on an average net margin of Rs. 52593.8/t in *puti shidal* and Rs. 197221.1/t in *bashpati shidal*. Net margin accounted for about 20% of the total revenue. **I**n Manipur cost of production of matka shidal was Rs. 285130/t and net return was Rs. 77065.31/t which constituted about 21.28% of total revenue. Smoking of fish in Manipur is very important economic activity performed fishermen families mainly in winter and summer seasons. On an average in a month about 391 kg of wet fishes were processed by a fishermen family and out of it they produce 156.58 kg of smoked fishes. Total cost and gross return on production of smoked fish were Rs 157265/t- and Rs. 195734/t, respectively and they earned Rs. 70,400.7/t which constituting almost 36% of total revenue. A fishermen family earned

net income of Rs. 11,023.34 per month from fish smoking. This finding clearly indicate that smoking is a viable and employment generating avenue for the fishermen family. These results shows that the indigenous practice of value addition in fish is income and employment generating economic activities and since women involvement is more in these activities hence it also help in economic empowerment of women in the region. For further commercialization of indigenous value added fish products in NE region, skill development of SHGs, financial support and development of market linkage are crucial.

T5A-45

Production of Spirulina from wastewater

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Abstract

Spirulina is a biomass of cyanobacteria cultivated worldwide for consumption by humans and animals or other purposes such as pigment production, polysaccharides, carotene, sterols, vitamins and polyunsaturated fat etc. It contributes 30% of the total single cell algae biomass production in the world. However, most production system chemical-based culture medium which contributes 30% of the total production cost. Meanwhile, the production of fish is increasing day by day which also contributes to several environmental impacts like discharge of wastewater in the environment without treatment. There are some scientific works which has the main objective of producing spirulina from this wastewater. At the same time the production of spirulina biomass will reduce the inorganic substances such as ammonia, nitrite, nitrate and the dissolve nutrients which can cause eutrophication to a great extent. The production of spirulina can reduce the environmental pollution issues by making the effluent suitable for reuse in fish pond or disposing in the environment. Moreover, the wastewater will reduce the use of chemical-based culture medium and reduce the production cost. The research should be more focused on developing low-cost culture medium for production of spirulina biomass.

Keywords: *Spirulina; Cyanobacteria; Wastewater; Chemical-based culture medium; Inorganic substances*

T5A-46

Evaluation of different methods to improve survival rate and growth performance Amur carp (*Cyprinus carpio haematopterus*) in nursery pond

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Abstract

The present research was conducted to investigate the effect of different doses of fertilizers in the nursery rearing of Amur carp. The experiment was carried out from spawn to fry. Spawn to fry showed maximum average weight in treatment T_2 - (mixture of organic and inorganic fertilizers) followed by T_1 (mixture of GOC and Cow dung), T_3 (Cow dung + SSP and Urea) and control groups T_0 (Cow dung). There was significant difference ($P<0.05$) observed in between the treatments and control. The survival percentage was observed high in T_2 (42.98%) followed by T_3 (41.01%**),** T_1 (40.18%) and T_0 (34.08). The water quality parameters recorded during the study period. Plankton concentration was maintained at 64-140 nos/L for phytoplankton and 59-67 nos/L for zooplankton. The results demonstrate that use of fertilizer was suitable in spawn to fry helped in better growth and survival of Amur carp.

Keywords: *Spawn to Fry, Fertilizer, Physico-chemical characteristics of water, Plankton*

T5A-47

Standardization of sustainable management practices for soybean-based cropping system

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Abstract

Natural farming which is also referred to as 'Fukuoka method' or 'Do nothing Farming', is a chemical free farming system. It mainly aims in environment conservation, rejuvenates soil health, efficient use of natural resources and minimizing the cost of input. The leading states which practiced natural farming are Andhra Pradesh, Karnataka, Himachal Pradesh, Gujarat, Uttar Pradesh and Kerala. Currently the acceptance of natural farming is at early stage and its popularity is gaining gradually among the farming community. Based on this, a trial was started at Central Farm, Lamphelpat, CAU, Imphal to standardized the sustainable management practices (Natural/organic/integrated crop management) in soybean-based cropping systems. The trial was conducted in split plot design with cropping system viz. soybean-chickpea and soybean-maize in main plot and sustainable management practices viz. natural, organic and integrated crop management in sub plot. The cropping system treatment was found to be non significant. However, under sustainable management practices, higher seed yield was found in integrated crop management practice (1522 kg/ha) over organic management practices (1361 kg/ha) and natural farming (1069 kg/ha).

Key words: *Soybean, sustainable management, natural farming*.

T5A-48

Potentials of Integration of Black Turmeric under Agroforestry System for Livelihood Improvement of Local Community in West Garo Hills

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Abstract

The integration of black turmeric (Curcuma caesia) within agroforestry systems presents a promising avenue for enhancing the livelihoods of local communities in the West Garo Hills of Meghalaya. Black turmeric, a valuable medicinal plant indigenous to the North Eastern regions, holds significant economic and cultural importance, particularly for indigenous communities residing in the region. This review explores the potential of integrating black turmeric cultivation within diverse agroforestry systems to improve the livelihoods of local communities in the West Garo Hills. Through a participatory research approach, involving collaboration with farmers, community members, and stakeholders, the study assesses the agronomic feasibility, socio- economic impacts, and ecological benefits of incorporating black turmeric into existing agroforestry practices. Socio-economic surveys, and stakeholder consultations are employed to gather data and insights into the performance of black turmeric under different agroforestry configurations, including homegardens, mixed cropping systems, and silvopastoral systems. The study evaluates factors such as soil fertility, microclimatic conditions, companion tree species, and market opportunities to assess the suitability and viability of black turmeric cultivation within agroforestry systems. The integration of black turmeric into agroforestry systems offers numerous benefits for local communities, including enhanced income generation, diversification of livelihoods, improved soil health, biodiversity conservation, and resilience to climate variability. The cultivation of black turmeric alongside multipurpose trees provides additional income, while also contributing to environmental sustainability and ecological resilience. The study underscores the importance of promoting agroforestry as a sustainable land-use practice for fostering the conservation, cultivation, and commercialization of black turmeric, thereby enhancing the socio-economic well-being of local communities in the West Garo Hills.

Keywords: *Homegardens, Indigenous communities, Rural development, Socio-economic*

T5A-49

Nutritional security in Horticultural crops

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Abstract

Conventional farming methods rely heavily on chemical inputs and are unsustainable and lead to soil degradation, nutrient imbalances, and water pollution. Excessive chemical fertilizer use can stress plants and their environment. There is a growing need for alternative agricultural practices to address these challenges and improve productivity. Integrated Nutrient Management (INM) provides a solution integrated nutrient management is the most appropriate approach for managing the nutrient input which involves the combined use of chemical fertilizer, organic manures, and bio-fertilizer for the maintenance of long-term soil fertility and productivity alongwith sustainable crop production. Organic manures like farmyard manure are bulky organicmanure, which is a storehouse of major nutrients apart from containing a considerable amount of macro and micronutrients, and improves all soil properties and brings nitrogen through organic manures Secondly, the use of organic manures increases the organic matter content of the soil by increasing the water holding capacity. Biofertilizers are carrier-based microorganisms used for maintaining soil health. They play an important role in plant nutrition through nitrogen fixation and transform different nutrients into available forms (eg. phosphorus solubilizer) and help the Plant survive in stressful conditions. Vermicompost is an eco-friendly natural fertilizer prepared from biodegradable organic waste, rich in micro and macro plant nutrients. Azospirillium is an alternate source of nitrogen in non-leguminous crops. Which fixed the atmospheric nitrogen and PSB used for phosphate solubilizing microorganisms which grow and release organic acid that dissolves unavailable phosphate into soluble form and makes it available to the plant. An integrated nutrient management approach has demonstrated its effectiveness in predicting soil nutrient accumulation for ensuring crop nutritional security and enhancing the growth of growing plants.

Keywords: *Integrated nutrient management, Conventional farming, Biofertilizers, Farmyard manure, Azospirillium*

Theme 6; Artificial Intelligence for Futuristic Agriculture

T6A-1

Artificial intelligence for futuristic animal husbandry

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Abstract

Artificial intelligence (AI) is revolutionizing animal husbandry, offering futuristic solutions to enhance productivity, welfare, and sustainability. By leveraging AI-driven analytics, precision monitoring, and predictive modeling, farmers can optimize breeding programs, manage livestock health, and streamline resource allocation. AI-powered sensors and robotics enable real-time data collection, allowing for early detection of diseases and precise interventions, minimizing loss and maximizing yield. In addition to optimizing traditional practices, AI facilitates the development of novel techniques such as virtual fencing and autonomous herding, reducing the need for physical barriers and human labor while promoting animal welfare. Moreover, AI-driven genetic selection models accelerate breeding programs, enhancing livestock resilience and productivity in the face of changing climates. Furthermore, AI algorithms analyze environmental factors to customize feeding regimes, reducing waste and environmental impact. Through machine learning, AI systems continuously improve decision-making, adapting to changing conditions and optimizing outcomes over time.

T6A-2

Artificial intelligence for futuristic animal husbandry/ veterinary

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Abstract

As the global demand for animal products continue to rise, the agricultural sector faces unprecedented challenges in meeting these needs efficiently. Artificial intelligence emerges as a transformative tool in revolutionizing animal husbandry practices. It includes precision livestock farming, health monitoring, breeding programs, and environmental sustainability. Farmers can therefore, optimize resource utilization, enhance animal welfare, and mitigate disease outbreaks. Furthermore, AI driven predictive analytics empower decision making process, enabling proactive measures to address potential challenges. Thus, AI can help transform animal husbandry into a more efficient, sustainable, and ethical practice.

T6A-3

Artificial intelligence for futuristic animal husbandry/veterinary

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Abstract

Artificial intelligence (AI) stands as a transformative force poised to revolutionize animal husbandry and veterinary care. By leveraging AI technologies such as machine learning, predictive analytics, and computer vision, the future of animal management and healthcare appears promisingly optimized. Through AI-driven systems, practitioners can expect enhanced disease detection, real-time monitoring of animal behaviour, and tailored nutritional interventions. Precision husbandry techniques, facilitated by AI, hold potential to individualize care, promote sustainability, and minimize environmental impact. However, alongside these advancements come significant ethical and practical considerations. Responsible implementation and interdisciplinary collaboration are imperative to address concerns surrounding data privacy, algorithm bias, and the ethical treatment of animals. Despite challenges, the integration of AI in animal agriculture offers a pathway towards improved efficiency, sustainability, and animal welfare in the years to come.

T6A-4

Harnessing Artificial intelligence for futuristic agriculture

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Abstract

Futuristic agricultural technologies are reshaping farming practices, offering farmers unprecedented tools to enhance crop yields, minimize environmental impact, and streamline operations. Through the integration of cutting-edge advancements such as AI, drones, IoT, and robotics, precision farming is becoming a reality. These innovations enable real-time monitoring of soil fertility, weather patterns, crop health, and growth metrics, empowering farmers with invaluable insights for decision-making. In India, IoT plays a pivotal role in gathering essential data on soil quality, weather conditions, crop development, and various agricultural activities. Leveraging IoT technology, farmers access crucial information through sensors, smart cameras, mobile applications, and miniature chips. This interconnected network enables automated processes that optimize resource utilization, addressing the scarcity of resources while resolving agricultural challenges at every stage, from optimal seeding times to harvesting strategies.By harnessing the power of internet-based technologies, farmers are equipped with comprehensive tools to monitor and manage their operations efficiently. This digital transformation revolutionizes traditional farming methods, promoting precision, sustainability, and resilience against factors like climate change. Through IoT-driven automation, farmers can make informed decisions, ensuring the judicious use of resources and effectively addressing agricultural complexities, thus paving the way for a more prosperous and sustainable future in agriculture.

Keywords: *Precision farming, IoT technology, Automation, Sustainability, Decision-making.*

T6A-5

Remunerative Approaches of Artificial Intelligence in Agriculture Development

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Abstract

The United Nations Food and Agriculture Organization stated that the global population will rise by another 2 billion in 2050, but the increase of farming area will only be 4% by that time. Leveraging latest technological advancements for addressing the growing demand of the population is the only viable solution to the current situation. National Strategy for Artificial Intelligence(AI) released by NITI Aayog in 2018 identified agriculture as one of the focus areas. Many Indian farmers are now able to increase their yields and tackle various problems after merging AI to their farm. AI has advanced learning capabilities with the help of which it becomes a crucial approach for assisting farmers in choosing suitable crops, managing pests and diseases, adopting improved soil condition and nutrient management practices, estimating crop production and forecasting prices of commodities. It utilizes artificial neural networks, Internet of Things, image processing and many other advanced methodologies to overcome the various challenges of the farm. The World Economic Forum's Artificial Intelligence for Agriculture Innovation (Al4AI) initiative led by the Centre for the Fourth Industrial Revolution (C4IR) India, brings together the government, academia and corporates to jointly develop and implement innovative solutions to the challenges of the agricultural sector. The "Saagu Baagu" project under AI4AI has considerably increased the yields and doubled the incomes of chilli farmers of Telangana through AI and data management. Microsoft with collaboration with United Phosphorus Limited (UPL), led to the creation of a Pest Risk Prediction API that leverages AI and machine learning to indicate in advance the risk of pest attack in the farms of Maharashtra, Madhya Pradesh and Telangana. OmniAI.Club's AI tools are assisting farmers of NE region in analyzing soil health, weather patterns, crop viability, disease prediction thus leading to informed decision-making and reducing crop loss. Many startups like AgSpert, AgriJod are consistently striving to explore the possibilities of AI in the farms of north-east India. Thus, AI holds immense potential for transforming the futuristic agriculture of India and ensuring food security for the future generations.

T6A-6

Artificial intelligence for futuristic agriculture

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Abstract

India is an agrarian country since prehistoric times, profoundly rich in global biodiversity and cultural heritage, with maximum population directly or indirectly depending on agriculture and its allied sectors for their livelihood. Since, traditional farming methods lack in supplying as per continuous growing food demands, our beloved country is facing various hardships and challenges, and has to be artificially revolutionized following the footsteps of other developed countries. Artificial Intelligence (AI), the latest hi-tech system, incorporated into the agricultural field have surplus advantages like cost efficiency (inputs-saving), automation (time-saving), robotics application (labour-saving), data-based decisions, weather and price forecasting, crop health monitoring, precision farming, intelligent spraying, disease

diagnosis, etc. These recently employed systematic activities can result in higher quality and quantity of crop yields per unit area, while also encompassing time and other inputs usage. AI innovations have adverse futuristic potential and applications in the field of agriculture, modernizing and bringing-forth a new revolutionary phase in solving or tackling against the biggest problematic topics of today's generation such as world hunger and unemployment, climate change and ecosystem depletion, overpopulation and meeting food demands. Its principle aim is towards sustainability, effectivity and preciseness in action. The central Government had also introduced AI for emphasizing more importance towards the country's national assets i.e. farmers. The world's highest population of vegetarians resides in our country and critically puts more weightage upon this sector. Therefore, farmers must be given primary importance for their hard work and dedication, their respectable status should be re-acknowledged as well as preserved. Farmers drive the country's economy, feeding millions of population everyday and are no less important than professionals from other fields. The Government should implement maximum financial support schemes and newest technologies with training programmes for farmer's welfare.

T6A-7

Artificial Intelligence for Futuristic Agriculture

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Abstract

With the world's population continuing to grow and climate change impacting agricultural productivity, finding innovative solutions for more efficient and sustainable farming practices is crucial. Artificial intelligence (AI) holds immense potential to revolutionize agriculture by enabling data-driven decision-making, automating processes, and optimizing resource utilization. Here explores the transformative role of AI in futuristic agriculture, highlighting its applications across various domains. Precision agriculture leverages AI algorithms, machine learning models, and advanced sensors to provide site-specific crop management recommendations, optimizing inputs such as water, fertilizers, and pesticides. AI-powered predictive analytics can forecast crop yields, detect pests and diseases early, and suggest preventive measures, minimizing losses and maximizing profitability. Robotic systems equipped with AI and computer vision capabilities can automate labour-intensive tasks like harvesting, weeding, and pruning, reducing the need for manual labour and increasing efficiency. AI-driven greenhouse automation enables precise control over environmental factors, optimizing growing conditions for maximum yield and quality. Furthermore, AI can facilitate the development of drought-resistant and climate-resilient crop varieties through genomic selection and gene editing techniques, ensuring food security in the face of climate change. Additionally, AI-powered supply chain optimization can minimize waste, improve traceability, and enhance the overall efficiency of the agricultural sector. However, the integration of AI in agriculture also raises ethical concerns, such as data privacy, algorithmic bias, and the potential displacement of human labour. This paper discusses these challenges and proposes strategies for responsible AI adoption, ensuring that the benefits of this technology are equitably distributed and aligned with sustainable development goals. In conclusion, the integration of artificial intelligence into agriculture heralds a new era of innovation and sustainability, enabling farmers to navigate the complexities of modern food production with unprecedented precision and efficiency. By harnessing the power of AI-driven technologies, futuristic agriculture has the potential to feed the world's growing population while safeguarding the planet for future generations.

T6A-8

Artificial intelligence for futuristic agriculture

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Abstract

Agriculture plays a significant role in the economic sector. Automation in agriculture is the main concern and the emerging subject across the world. Artificial Intelligence plays an important role in shaping the future of agriculture. Precision farming helps farmers in making accurate decisions regarding plant health, soil health and to forecast weather patterns by analyzing data from satellites, drones and censors. Artificial Intelligence techniques such as machine learning and convolutional neural networks are applied to crop management that help to predict crop yields, monitor growth and optimize planting schedules. AI powered systems can detect early signs of plant diseases and pest infestations. AI can enhance supply chain efficiency by predicting demand, optimizing logistics and inventory management. By analyzing historical data and market trends, AI algorithms help ensure timely delivery of agricultural products to consumers. Artificial Intelligence plays a crucial role in innovative farming practices such as vertical agriculture. Due to rise in global population, AI technologies will be essential for meeting the increasing demand for food production. Artificial intelligence in agriculture offers immense potential for optimizing resources, increasing productivity, and ensuring food security in a changing world.

Key words: *Artificial intelligence, Precision farming, Crop management, Vertical agriculture*

T6A-9

Artificial Intelligence in Aquaculture & Fisheries: Current Breakthrough and Future Horizon

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Global fisheries production is steadily rising due to the aquaculture industry. For food and nutrition security in our nation and around the world, fish is essential. For this reason, it becomes imperative to boost fish output. However, it is dwindling as a result of several illnesses that could harm the country's economy. Early detection of illness-affected fish can assist us in taking the appropriate action to stop the sickness from spreading. The integration of Artificial Intelligence with Aquaculture has emerged as a transformative force. . Manual identification of fish disease is not an error-free task by amateur farmers. Therefore, a computer vision-based automated approach can be a considerable solution for the reduction of disease. The necessity of computer vision-based fish disease recognition has investigated.

Keywords: *Fish, Aquaculture, Data, Disease, Detection*

T6A-10

Artificial intelligence

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Abstract

Agriculture plays main role in economic sector. The population has been increasing day by day with this demand for food and employment is also increasing. Traditional methods which we our farmers are using will not be able to fulfil these requirements. So, at present situations to fulfil these requirements automation methods are most important. The automation in agriculture is the main concern and emerging subject across the world. Development in the agricultural sector will boost the rural development, further leading towards rural transformation and eventually resulting in the structural transformation (Mogili and Deepak, 2018; Shah et al., 2019). With the advent of technology, there has been observed a dramatic transformation in many of the industries across the globe (Kakkad et al., 2019). Surprisingly, agriculture which is least digitized, has seen momentum for the development and commercialization of agricultural technologies. Artificial intelligence (AI) has begun to play a major role in daily lives, extending our perceptions and ability to modify the environment around us (Kundalia et al., 2020; Gandhi et al., 2020: Ahir et al., 2020). Plessen (2019) gave a method for harvest planning based on the assignment with vehicle routing is presented. The various applications of artificial intelligence in agriculture such as for irrigation, weeding, spraying with the help of sensors and other means embedded in robots and drones. These technologies save the excess use of water, pesticides, herbicides, maintains the fertility of the soil, also helps in the efficient use of man power and elevate the productivity and improve the quality.

Keywords: *Artificial intelligence, Herbicide, Pesticide, automation, irrigation*

T6A-11

Artificial Intelligence (AI): Role in Transformation of Future Agriculture

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Abstract

According to the Food and Agriculture Organization of the United Nations, there will be an additional 2 billion people on the planet by the year 2050, yet just 4% of that new land will be under cultivation. Under such conditions, new technical developments and solutions to the farming industry's bottlenecks can be used to achieve more effective farming techniques. To help farmers make decisions, these tools are helpful for tracking, comprehending, and forecasting a variety of agricultural chain production parameters. Artificial intelligence in agriculture has the potential to streamline operations. AI is being used in agriculture in a few nations, such as Singapore, the United States, and others, and the results have been positive in terms of crop yield. A direct implementation of machine intelligence or artificial intelligence in the farming industry may represent a paradigm shift in the way that farming is carried out today. AI-powered farming solutions allow farmers to achieve more with less, improving quality and guaranteeing a speedy go-to-market strategy for crops. The function of artificial intelligence (AI) in identifying the type of soil and suggesting appropriate plants, calculating the amount of water needed for crops, periodically retrieving the mineral contents in the soil and notifying farmers to add appropriate minerals when needed, spotting plant diseases and notifying farmers of them, projecting the cost of agricultural products, and suggesting the best time to plant and harvest. Farmers may optimize field inputs, treat treatments, and regulate water flow by using the advice provided by these systems. By evaluating the soil and water availability, drones gather information from the farm and simplify the process of determining the ideal spot to grow

crops. In order for smart and precise agriculture to meet the rise in production and productivity needed to keep up with the growing population, artificial intelligence (AI) and the Internet of Things (IoT) will be essential.
Keywords: *Artificial Intelligence, AI, Future, Technology, Farming*

T6A-12

Artificial intelligence on plant disease detection and diagnosis and management

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Abstract

Artificial Intelligence (AI) has emerged as a transformative technology in agriculture, offering innovative solutions for disease detection and diagnosis in plants. In agriculture these AI tools mainly focus on precision agriculture, predictive analysis, crop and soil monitoring, disease diagnosis, supply chain optimisation, crop yield prediction and many more The implementation of AI in the realm of phytopathology has seen significant progress, with AI algorithms being utilized to analyse images of plants, discern disease symptoms, and predict potential disease outbreaks.AI tools deals with different domains including Machine learning, Deep learning, Expert system, Fuzzy logic, Internet of things and Robotics. There are lots of AI based apps like platix,agrio,crop doctor, rice doctor leaf doctor which provide enough information's about the focused areas of these apps. Many advantages are holding the AI which includes precise disease diagnosis through image analysis and pattern recognition, Rapid processing of large datasets enables early detection and timely intervention, AI technologies reduce manual labour and resource wastage in disease management, AI systems can be scaled to monitor vast agricultural regions efficiently and AI fosters innovation in disease management strategies, leading to sustainable agriculture practices but they are also concerned with many problems like AI algorithms require substantial datasets for training, which may be limited in certain regions or for specific diseases, Skilled personnel are necessary to develop, maintain, and interpret AI systems accurately, The black-box nature of AI models may hinder the understanding of decision-making processes, Issues related to data privacy, algorithm bias, and transparency need to be addressed when implementing AI in phytopathology. AI has brought about a paradigm shift in phytopathology, offering advanced tools for disease detection and diagnosis in plants. Despite some challenges, the benefits of AI in enhancing crop health and productivity outweigh the drawbacks. Continued research and collaboration are essential to leverage the full potential of AI in phytopathology and drive agricultural sustainability.
Keywords: *expert system, algorithms, Outbreak, Artificial intelligence, Recognition, Accuracy*

T6A-13

Artificial intelligence in Horticulture: Unmanned aerial vehicles for horticultural crop phenotyping

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Abstract

Crop phenotyping is an essential aspect of horticulture research and production, as it allows the quantification and analysis of plant characteristics and traits. Traditional methods of phenotyping involves tedious manual measurements, which are time-consuming and limited in their ability to capture spatial and temporal dynamics of plants. In recent years, unmanned aerial vehicles (UAVs) have emerged as a promising technology for crop phenotyping, offering a non-invasive and efficient means of data collection. UAVs equipped with digital cameras can quickly acquire grayscale or color images to estimate leaf angel distribution, lodging and leaf color (Ballesteros *et al.*, 2014). Geometric traits, such as crop height, vegetation cover fraction, fraction of intercepted radiation, tiller densities, and emergence, can be rapidly obtained using the spectral and texture information in the images acquired by a UAV deployed imaging sensors (Tamouridou *et al.*, 2017). Furthermore, UAVs with spectral imaging sensors can obtain the spectral absorption and reflectance characteristics of crops, which can be used to monitor the crop planting area and crop growth, to evaluate the biological and physical characteristics of a crop, and to predict crop yield (Nigon *et al.*, 2015) The challenges and possible future of UAV-based crop phenotyping in horticulture must be highlighted. These include creating standardised methods and workflows, combining various data sources for thorough phenotypic analyses, and using unmanned aerial vehicles (UAVs) on their own to gather data. In the end, horticulture's embrace of UAV-based phenotyping techniques holds enormous promise for enhancing breeding initiatives, precision agricultural methods, and crop output.

T6A-14

Artificial Intelligence: The Future of Agriculture

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Abstract

With a growing global population with finite resources, feeding is a pressing challenge. Artificial intelligence (AI) emerges as a game-changer for agriculture, promising to optimize yields, minimize waste, and revolutionize farm management. AI-powered solutions transform various aspects of farming, including: *Precision agriculture:* AI analyses vast datasets from sensors, satellites, and weather stations to predict crop health, optimize resource allocation, and maximize yields. *Robotic automation:* Tasks like weeding, harvesting, monitoring livestock can be automated using AI, freeing human labour. *Pest and disease control:* Analysis of drone imagery and sensor data allows pest and disease detection and proper management practices to reduce losses. *Geo-Fencing:* Locating disease affected areas by the help of AI-powered drones and following proper quarantine practices. *Yield prediction:* Historical data and Real-time environmental conditions allow AI models to predict future yields and manage proper resource allocation. *Experimental Varieties:* With the help of AI, new varieties of crops could be formulated by the process of permutations, which might give rise to better crop varieties. *The impact of AI* extends beyond increased efficiency. AI can: *Bridge the gap between conventional and organic farming* by optimizing organic practices for yield improvement. *Enable sustainable practices* by minimizing water usage, reducing pesticide application, and promoting soil health. *Empower smallholder farmers* by providing them with affordable AI-powered tools for better decision-making. *Challenges and considerations* include: *Data security and privacy* of sensitive information. *Accessibility and affordability* of AI technologies for all farmers. *Ethical implications* such as potential job displacement in the agricultural sector. *In conclusion,* AI holds immense potential to transform agriculture into a more productive, sustainable, and data-driven industry. Addressing the challenges ensures that this technology empowers farmers cultivating a future of food security for all.

T6A-15

Transforming agriculture supply chains: The role of machine learning and artificial intelligence

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Abstract

The agriculture industry is on the cusp of a revolution, driven by the increasingly important role of technology in optimizing supply chains. The integration of machine learning (ML) and artificial intelligence (AI) is transforming the way agricultural products are grown, harvested, processed and distributed. AI-powered systems are enabling farmers, suppliers and distributors to make data-driven decisions, predict market trends, and improve operational efficiency. The study investigates how AI can unlock supply chain potential within agriculture by conducting a systematic literature review adhering to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) framework. By comprehensively analyzing relevant databases like JSTOR, AGRIS, Elsevier's ScienceDirect, AgEcon Search, BASE, CORE, Semantic Scholar, Science.gov and Google Scholar. The study captured a comprehensive picture of research published between 2004 and December 2023. This time frame ensures the inclusion of both foundational and cutting-edge research on AI's role in agricultural supply chains. This multifaceted approach provided valuable insights into key research actors, prominent themes and underlying connections within the field. This could involve pinpointing specific AI applications like farm management, quality control, predictive analysis, supply chain optimization, customer segmentation, targeted advertising and traceability and transparency *etc.*, Ultimately, the transformation of agriculture supply chains through ML and AI has the potential to make a significant impact on global food security, sustainability, and economic development.

Keywords: *Supply chain, Artificial intelligence, Agriculture, Machine learning*

T6A-16

AI in Agriculture sector and Agriculture industry

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Abstract

The integration of Artificial Intelligence (AI) into agriculture and farming is reshaping the food industry, leveraging various technologies such as robots, drones, autonomous tractors, and crop monitoring machines. Central to this transformation is the reliance on vast datasets to train AI models, enabling computer vision systems to recognize objects and patterns essential for predictive analytics. These datasets play a critical role in advancing agricultural practices by facilitating the identification of similar objects and storing relevant information for future predictions. AI in agriculture offers a multitude of applications, including AI-based robots for harvesting, soil and crop health monitoring systems, automation, and robotics to reduce manual labor, and leveraging big data for informed decision-making. With the projected increase in the world's population by 2 billion people by 2050, there is a pressing need for a significant growth

in food production—estimated at 60 to 70%. COGITO, an expert in agricultural data annotation, is at the forefront of developing successful AI models tailored to the farming sector. By maximizing efficiency and production in the food industry, COGITO contributes to meeting the challenges of feeding a growing population sustainably. The company specializes in creating customized datasets for various agricultural machinery, including robotics, automated plowing, and harvesting machines. Utilizing leading image annotation techniques such as bounding boxes and semantic segmentation, COGITO ensures the accuracy and relevance of training data, thereby optimizing the performance of AI systems in agricultural settings. Thus, the integration of AI in agriculture holds immense potential to revolutionize farming practices, increase efficiency, and address the global challenge of food security in the coming decades.

Keywords: *Artificial intelligence, agriculture, robots, drones, soil, crop, health, COGITO*.

T6A-17

Artificial Intelligence (AI) in plant disease detection and diagnosis for futuristic agriculture

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Abstract

Plant diseases pose significant threats to global agriculture, jeopardizing food security. Conventional disease detection methods are labour-intensive and prone to errors. The incorporation of Artificial Intelligence in various fields of research and development has emerged rapidly due to its precision and ease of use. Hence, Artificial intelligence (AI) presents a promising avenue for automating disease diagnosis in plants with respect to minimizing disease development in agricultural crops. This will benefit the farming community as a whole, and needless to say, this development will bring a new scope of invention and will fuel the businesses of Agri-preneurs. This literature review explores the integration of AI, particularly computer vision and machine learning, into plant disease detection systems. Deep learning enables machines to acquire knowledge from past instances, akin to human learning. However, implementing AI in agriculture encounters challenges such as data scarcity, variable field conditions, and the need for interpretable models. Future research directions include developing robust generalized models, integrating AI with Internet of Things (IoT) or precision farming technologies, and exploring AI-driven decision support systems for plant disease management. This article provides an overview of imaging techniques and computer vision methodologies employed in the detection and classification of plant diseases. It also discusses the prevailing trends and challenges encountered in this domain.

Keywords: *Artificial Intelligence, Plant disease detection, Computer vision, Machine learning, Deep learning, Internet of Things*

T6A-18

Enhancing Livestock Productivity Through AI-based Extension: A Comprehensive Approach

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Abstract

Livestock farming is a cornerstone of global agriculture, providing essential resources such meat, milk and eggs. It is necessary to increase livestock productivity in order to satisfy the rising demand for animal products while maintaining sustainability. However, optimizing productivity and managing livestock sustainably present numerous difficulties. It is astounding how far agriculture has come in the past century. A seemed unattainable; today, however it is now imperative that we make use of the newly emerging Artificial intelligence (AI) based extension services in the livestock sector. Extension services provide a comprehensive strategy for managing livestock by utilizing the power artificial intelligence, machine learning and data analysis. Predictive analysis for prevention, real-time animal health, monitoring and precise feeding plans are all examples of artificial intelligence base extension services. It highlights how data driven insight can help the farmers make wise decision that improve animal welfare, increase yields and use applications guarantee that farmers of all size can gain from customized recommendation and professionals advice. AI-based services can help livestock farmers close the knowledge gap, encourage sustainable practices and lessen their impact on the environment. To provide individualized and data-driven recommendation and solution which aimed at improving livestock productivity, welfare and general management these services make use of AI algorithms, machine learning, data analytics and digital tools.

Keywords: *Artificial intelligence, Data, Machine learning, Livestock*

T6A-19

Leveraging Digital Technologies for Sustainable Agricultural Growth: The Role of AI in Enhancing Crop Production and Soil Management

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Abstract

Technologies like computer science, Internet, giant information Analytics, Block Chain Technology etc. computer science provides correct and timely data regarding plants, land, climate and insects etc. for farmers; so, it's going to improve crop production at a reduced risk resulting Agriculture faces major challenges. Increasing production by seventieth to full-fill world demand over subsequent fifty years could be a risky goal because of restricted resources, temperature change and different short-run and regional threats. Agriculture is that the largest sector within the world. Doubtless, it's the most important supplier of livelihoods in Asian nation; particularly in rural India. Agriculture is that the backbone of the Indian economy. The Indian government has set itself the goal of doubling farmers' financial gain by 2022 and also the Agricultural Export Policy has set a target to extend agricultural exports. Digital technology will play a transformative role in modernization and coming up with however rural Asian nation performs its agricultural activities in improved financial gain for farmers. Objectives: This present study explores how (AI) Artificial intelligence can help in fulfilling the demand which is going to rise in future and helps in producing agricultural produces in bulk quantity, also role of AI in nutritional assessment and management of soil.

Keywords: *Artificial intelligence, Data, modernization, Agriculture*

T6A-20

Emerging frontiers: AI powered solutions in futuristic plant disease management

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Abstract

In the relentless pursuit of sustainable agriculture, the fusion of artificial intelligence (AI) and plant disease management stands as a beacon of innovation. This abstract embarks on a journey through the intricate landscape of AI-driven disease diagnosis in plants. Delving into the intricate tapestry of machine learning, deep learning, and image processing, it unveils a mosaic of methodologies poised to redefine the boundaries of precision agriculture. With meticulous attention to data quality and algorithmic finesse, it lays the groundwork for a new era of diagnostic prowess. This also orchestrate a symphony of AI applications in agriculture, with a virtuosic emphasis on disease management. Their opulent narrative intertwines AI with the ethereal realms of the Internet of Things (IoT) and unmanned aerial vehicles (UAVs), ushering forth a renaissance of smart farming. Through a chiaroscuro of real-time disease detection and resource optimization, they compose an ode to agricultural enlightenment. This cast their scholarly gaze upon the fertile fields of crop disease detection and diagnosis, painting a vivid tableau of AI's transformative potential. Their opus magnum weaves a tapestry of image analysis techniques, each brushstroke a testament to computational elegance. Amidst the verdant pastures of texture analysis and segmentation, they sculpt an epitaph for conventional paradigms, heralding the dawn of automated disease identification. In conclusion, this triptych of scholarly excellence beckons us to the vanguard of scientific inquiry, where the alchemy of AI and agriculture promises to transmute the base elements of challenge into the golden harvest of opportunity. As we stand on the precipice of agricultural renaissance, let us seize the mantle of innovation, forging a legacy of sustainability and abundance for generations to come.

Keywords: *Artificial intelligence, Sustainable agriculture, AI application, Disease diagnosis, Disease management, Precision agriculture*

T6A-21

Artificial Intelligence (AI) for Futuristic Agriculture: Future of Indian Agriculture and Its Challenges

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Abstract

Machines had been trained to think like people and act like them are said to be AI, which is a simulation of human intellect. The phrase may also be used to describe any computer that demonstrates characteristics of the human mind, such as learning and problem-solving abilities. The most widely used and constantly applied method for research purposes is ANN (Artificial Neural Network). ANN is a task-based strategy that instructs the system to work based on a preprogrammed task rather than a computationally designed task. FAO of the United Nations predicts that by 2050, there will be an additional 2 billion people on the planet, but the additional land area under cultivation will only make up 4% of all land area under cultivation. In this case, it is possible to improve agricultural practices by addressing current farming obstacles with cutting-edge technological innovations and solutions, such as ICT tools. A direct application of AI across the farming sector could make a paradigm shift on present day farming. Major AI activities used in farming are smart irrigation system, Hortibot wedding, autonomous tractor and crop health monitoring and so on. The challenges in

adopting AI are; Response time and accuracy, big data management, method of implementation, high data cost, flexibility to the different location and employment standard (Ngozi Clara Eli-Chukwu, 2019).

T6A-22

'AI4CORB', an AI Driven e-learning Multi-Media aid for IDM of Rice Blast: An Ex-ante Case

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Abstract

Artificial Intelligence (AI) technology is developing at a rapid pace, causing revolutionary changes in many different industries. Technology is always evolving, giving rise to new cultures and educational approaches. AI represents new digital technology that have great power to change society. AI enhanced Multi-Media for learning had more positive results towards learners. The 'Rice Blast' is reported to be one of the commonest diseases of paddy in the 'Rice Bowl' region of Meghalaya at paddy fields in villages of Bhoirymbong C&RD Block of Ri-Bhoi district. Multiple extension approaches such as training, demonstration, field days etc. to train farmers towards scientific management of 'Rice Blast' yielded unsatisfactory learning by the rice farmers. Hence teaching tools focus on this issue has been felt need of extensionists. Subsequently, the preceding paraphernalia led to the three research objectives viz., (1) To understand the level of awareness of farmer on IDM of Rice Blast; (2) To create an Artificial Intelligent Multi-Media teaching aid for IDM of Rice Blast; and (3) To examine the effectiveness of Multi-Media teaching aid for IDM of Rice Blast. The study followed Exploratory Research Design. Purposive sampling method was administered in order to select 20 respondents. The scientific inquiry could unveil that majority (65%) of the respondents were in middle age groups and 55% of the respondents were female. Higher percentage (40%) of the respondents had primary level of education. Inquisitively, it was observed that more than half of the total respondents (55%) had low level of awareness on IDM of 'Rice Blast'. The study could create an Artificial Intelligent Multi-Media teaching aid for Control of Rice Blast (a.k.a AI4CORB) using ChatGPT +4 and DALL E.3. A statistically significant effectiveness @ 0.01 level of significance on awareness and understanding on IDM of Rice Blast by respondents of the study was observed owing to the intervention of AI4CORB. The scientific inquiry recommends to establish training programs for farmers using AI based multi-media tools to enhance immersive learning and understanding of complex-abstract- cognitive domains of farming.

Keywords: *AI4CORB, Rice Blast, Artificial Intelligent, DALL.E, ChapGPT+4*

Theme 7; Ideathon in agri-allied sectors (Start-up Idea Pitching)

T7A-1

Assessing Millets Consumption Behaviour among Diabetic Patients: A Case Study in Urban Kerala

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Abstract

Millets have been a part of our diet for years. To create awareness and increase the production & consumption of millets, the United Nations, at the behest of the Government of India, declared 2023 the International Year Millets. The present study is an attempt to assess millet consumption behavior among diabetic patients of urban Kerala. Kerala is considered the diabetes capital of India. The study was conducted with 250 respondents distributed equally among Kozhikode which is a major city in the Malabar region, Ernakulam which is a major city in the region of Kochi and Thiruvananthapuram the capital city of Kerala which is a major city in Travancore region. Along with the awareness and perception of diabetic patients towards nutritive value and health benefits of millet and millet-based products, the study also studied factors influencing millet & millet-based product consumption behavior of diabetic patients. Theoretically, the study is based on the theory of planned behavior which is an extension of the theory of reasoned action. From the study, it was observed that Out of the 250 respondents, 58.1 percent of diabetic individuals included millets in their diet. Data analysis was conducted using SPSS software using inferential statistics (chi-square) to test the hypothesis. Results indicate a growing interest among urban diabetic individuals in incorporating millets into their daily diet. Factors such as availability, affordability, and knowledge emerged as a critical determinants of intention to consume millet among diabetic patients. Various factors can influence the consumption pattern of individuals, including age, the use of insulin by patients, and the dietary plan followed by the patients. Additionally, the type of millet that is most commonly consumed can also have an impact on consumption patterns. Other important strategies from the research are promotion of millets in the Public Distribution System and creating millet cafes across Kerala cities. Some important findings from this research could support the adoption of tailored interventions from health information campaigns that can be disseminated through local health centers and create partnership with diabetic support groups or association for the purpose of spread information about the role of millets for glycemic control and peer-to-peer support for better dietary habits especially in Kerala where diabetes and millet cultivation still live together.

T7A-2

Scope of Geo-tagging in Agriculture

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Abstract

Technological interventions have helped businesses to carve their way through bottlenecks in order to increase their efficiency in operations. Geo-tagging is a process where one can add geographical information through different media forms. Geo-tagging in agriculture can help the service providers and farmers to a substantial level. One such technology, known as Geo-tagging, is nowadays the talk of the town. Geo-tagging can help in crop health, pest control, crop yield and monitoring, irrigation sources, monitoring, Usage of manure and fertilizers, flooding and drought Prediction. One of the primary applications of geo-tagging in agriculture is in precision farming techniques such as Variable Rate Application (VRA) of inputs. By geo-tagging soil samples and crop health assessments, farmers can tailor input applications such as fertilizers and pesticides to specific areas within their fields, optimizing resource utilization and reducing input costs. Future Scope of Geo-tagging in Agriculture: One of the biggest challenges that the farmers face to adapt the geo-tagging technology is getting acquainted with its functionality. With GPS- enabled technology, farmers can easily tag and track their crops, livestock, and equipment with just a few clicks. The use of Geo-tagging in Agriculture is not only vital for precision farming but also provides wealth of benefits that we will be exploring in this presentation. By embracing Geo-tagging technology in Agriculture production systems worldwide; there is no doubt that thus innovative approach will continue transforming global food security through higher yield per acreage cultivated area amidst environmental challenges posed by climate change uncertainties such as droughts or floods.

Keywords: *Drought Prediction, Geo-tagging, GPS, Variable Rate Application.*

T7A-3

DRONE- As a toll for precision farming

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Abstract

DRONE (Dynamic Remotely Operated Navigation Equipment), also known as Unmanned Aerial Vehicle (UAV), is a device which can fly either with the help of autopilot and GPS coordinates on the pre-set course or can be operated manually with radio signals using the remote control or smartphone application. Precision Farming is about doing the right thing, in the right place, in the right way, at the right time (Prescribed Farming). Drones can be combined with various imaging technologies like hyperspectral, multispectral, thermal, and so on to offer farmers temporal and site-specific information about crop health, fungal infections, deficiency symptoms and so on. Drone thermography, which employs thermal sensors to provide an image that indicates the moisture content of the land, comes into play. Drones used for detection of pest hotspots are here referred to as sensing drones, whiledrones used for precision distribution of solutions are referred to as actuation drones. Normalized Difference Vegetative Index (NDVI) provides a measure of overall plant health and has frequently been correlated with crop yield. The NDVI sensors are mounted on the drone and field photographs are taken, later these photographs are analysed with the help of spectral libraries. Foliar application with the help of drone decreases labour usage and also increases the accuracy of application towards target. Drones could be New Era in Agriculture as they reduce human power in multiple activities and detect crop conditions.

Keywords: *Drone, NDVI, sensors and spectral libraries*.

T7A-4

Investigation of Students' Digital Competency: A study from Agricultural Colleges of Ri-Bhoi District, Meghalaya

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Abstract

In the era of artificial intelligence, citizen development hinges on digital competency, vital due to the global digital revolution. Digital education, leveraging technology and online platforms, serves as a practical approach to academic continuity. Higher education institutions worldwide have embraced this shift, essential for equipping both students and future educators with the requisite skills. University students are expected to have the necessary digital skills to fulfill the demands of the changing educational pattern and challenges of their future careers. Under this backdrop, this study has been undertaken to assess the digital competency level among the agricultural students of Ri-Bhoi district, Meghalaya, with the following objectives: (1) To explore the current digital competency levels of agricultural students. (2) To compare the digital competence level of agricultural students among genders and schools. The survey design was adopted, and data was collected from 200 students through Google Forms. The Digital Competence Framework 2.0 (DIGCOMP) was adapted. For data analysis, the Mann-Whitney U test and Kruskal-Wallis test were used to compare the

level of digital competency between genders and schools, respectively. The findings suggested that the majority of students demonstrate competence, with 40% categorized as competent, followed by 28% as moderately competent, and 11% as highly competent. However, concern arises as less than one fourth (21%) are categorized as less competent or incompetent. The findings revealed there are no significant differences between genders, but significant differences were found in digital competency across different schools. Our findings have implications for the design of digital higher education strategies to ensure effective learner participation, especially for higher education institutions in developing countries.

Key words- *Digital competency, Digital education, Gender, Higher education, Students*

T7A-5

Assessment of Information Seeking Behaviour of Students: A Case from Agricultural Colleges of Ri-Bhoi District, Meghalaya

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Abstract

In today's world, information is vital for scientific research, decision making in everyday life as well as for the socio-economic development of a country. Reliable information at the right time can avoid wastage of resources, time and effort. Students often face difficulty in finding quality information to fill up their information needs. Understanding their ways of seeking information can help the students to stay well informed through reliable information sources. The objectives of this study are i) to know the information needs of the students and ii) to study the information seeking behaviour of the students at agricultural colleges in Ri-Bhoi district. Survey research design was adopted to achieve the stated objectives. For data collection, the structured questionnaires were circulated among students. A total of 147 students participated in the survey. The data was analyzed using MS Excel 2021 and SPSS version 23 and put in the form of frequency and percentage. The Relative Importance Index was also determined for the various factor of information seeking behaviour. The findings shows that the students need information mainly for their study and research work. While they used different sources like course reading, friends and professors, they heavily rely on YouTube. Their information need on news/current events and health & wellness were usually gathered from Google, YouTube and Wikipedia. The findings also emphasis on the shifting role of library from just as a knowledge repository to a multifunctional space for information related activities. As overlapping of the library timings and class hour is the main problem face by students in information seeking, the working hour of the college library should be efficiently managed. As majority student relies upon online information sources, students must be given proper guidance on how to obtain quality and reliable information from these sources.

Keywords: *Behavior, information, library, retrieval, search*

T7A-6

Application of cutting edge drone technology in agriculture

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Abstract

The consumption of agricultural products will rise in tandem with the world population's daily growth, which is expected to reach 9 billion people by 2050. The growing need for food must be met on an urgent basis for every individual. With so many issues to address in today's world, the agriculture industry is the most promising. The lack of labor for farming is one of the primary issues. Other issues or challenges include severe weather, insufficient and ineffective fertilizer application, infections, illnesses, allergies, and other health issues brought on by chemical application (pesticides, insecticides, fungicides, etc.) or insect/animal bites. In agriculture, the use of cutting-edge technologies like drones has the possibility of encountering a number of significant or minor difficulties. The primary uses of drones in agriculture Bird control, soil and field analysis, crop monitoring, irrigation, and crop monitoring are the main uses of drones in agriculture. With these cutting edge technology farmers especially in hilly terrain and the ones practicing it on a larger scale can conveniently carry out operations such as application of fertilizers and pesticides at much lesser cost as the need of labour will be reduced, added are the benefits of lesser time consumption, efficient application of the chemical to be sprayed and reduced are the chances of poisoning while spraying. Drones are easy to operate and hence do not demand the requirement of much skilled labour. Overall Drone application in Farming decreases the work of a farmer and eases the most cumbersome task of application of chemicals in the field at a much a very less cost and saves time immensely.

T7A-7

Android applications in Modern Farming

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Abstract

We live in an era of digital transformation. Experts believes that by the year of 2025 India will see a massive digital eruption. Today mobile phone is used frequently by everyone especially farmers which is playing an important role in their daily life. Weather forecast, Pest and Diseases of plants, Market prices, Record keeping and any farm related information, can be accessed in their mobile phones. The integration of android application into modern farming techniques has significantly reshaped agricultural practices and increased productivity. The traditional methods used by the farmers are very slow and undependable. Large amount of crop is getting damaged in the field due to lack of information resources. Annually, such loss exceeds 40% in total production. In conclusion, the integration of Android applications into modern farming techniques is revolutionizing agriculture, empowering farmers with access to information, tools, and networks that were previously unavailable. However, challenges such as digital literacy, connectivity issues, and data privacy concerns must be addressed to ensure equitable access and maximize the potential benefits of these technologies for farmers worldwide.

Keywords: *farmers, android application, traditional methods, agriculture, modern farming*

T7A-8

Understanding the Entrepreneurial Ecosystem of *Kouna* (*Schoenoplectus lacustris)* crafts in Manipur

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Abstract

Handicraft sector plays an important role in the Indian economy offering substantial employment and contributing significantly to exports. Manipur's *Kouna* crafts have a distinct position due to their aesthetic value and ecofriendly nature. It is becoming popular both in the national and international market and is in great demand. Realizing its value and market demand, different actors have started facilitating the artisans for capacity development, value addition and linking them to potential markets. This has led to a burgeoning entrepreneurial landscape. To support and understand the local artisans, comprehending the entrepreneurial ecosystem is necessary. Hence the study was taken up with the objective to identify the components of the entrepreneurial ecosystem of *Kouna* crafts in Manipur. The research spanned Thoubal (major hub) and Imphal East Districts of Manipur, surveying 90 artisans through mixed methods. The components were conceptualized and identified through various literature reviews, key informant techniques, focus group discussion and semi-structured interview. The identified components were analyzed using the framework developed by Hussein *et al*., 2021 which comprises of six dimensions viz network and engagement, support services, education and training, regional culture, physical infrastructure, and government regulatory framework. The study shows that Artisans had most contact with community stakeholders, then market intermediaries, and least with academic & research institutions. Input supply was the most used service. Financial and Logistic service usage was low, while there was negligible mentoring and incubator service usage. Only few artisans received training on entrepreneurial aspects. Most artisans perceived that they have favourable attitude towards entrepreneurship and the regional culture was conducive for entrepreneurship development. Physical infrastructure like transportation and internet was perceived to be adequate, but storage facilities lagged. Almost all respondent artisans were not beneficiaries of any development schemes. Hence, collectively addressing the lacunae will not only nurture the existing artisan engagement but also fuel the ecosystem's growth by tapping into its entrepreneurial possibilities, fostering sustainable development and prosperity within the *Kouna* craft domain.

KeyWords: *Handicraft, Kouna, entrepreneurial ecosystem, Manipur*

T7A-9

Ideathon in Agri-allied sectors (Start-up Idea Pitching)

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Abstract

In the context of Ideathon in agriculture and allied sectors focusing on startup idea pitching, an example of a sustainable agriculture solution that could be pitched at such an event is the development of a cloud-based software that helps farmers manage their fields and track their activities efficiently. This software could integrate features like crop monitoring, irrigation scheduling, pest management, and yield forecasting to optimize farm operations and resource utilization. By providing real-time data and insights, farmers can make informed decisions, reduce waste, and enhance productivity while promoting sustainable practices. In the startup pitch, the emphasis would be on how this technology contributes to sustainable agriculture by promoting environmental protection, public health improvement, and economic and social equity, as outlined in the key principles of sustainable farming. The pitch would highlight how the software

addresses challenges such as food security, productivity, and natural resource availability by enabling farmers to make data-driven decisions that maximize yields while minimizing environmental impact. Overall, this example illustrates how innovative technology solutions, like the cloud software for farm management, can play a crucial role in advancing sustainable agriculture practices and addressing the pressing challenges faced by the agriculture sector today.

Keywords: *Crop-monitoring, integrate, management, productivity, security*

T7A-10

Entrepreneurship in beekeeping for income generation

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Abstract

The honey bee industry presents a unique landscape for entrepreneurship, characterized by its blend of traditional practices and modern innovation. Beekeeping creates a diverse array of opportunities generating employment to start up business with low investment fetching quick returns. Honey market is a very profitable enterprise for the farmers to supplement their family income and improve their socio economic status. Additional income is also obtained from value-added honey products and other by-products viz.,bees wax, royal jelly, bee propolis, bee venom and beekeeping equipments. Moreover, the increasing consumer demand for natural and sustainable products has created a favourable market environment for honey bee entrepreneurs. By using technological advancements, adopting best practices in beekeeping, and cultivating partnerships across the value chain, entrepreneurs can enhance their resilience and competitiveness in this dynamic sector. Entrepreneurship in honey bee industry holds promise for individuals and organizations seeking to contribute to environmental conservation, economic development and community empowerment.

Keywords: *Entrepreneurship, Beekeeping, Honey market, value-added honey products and by-products*

T7A-11

A Systematic Literature Review on Agrotourism Models: SALSA Approach

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Abstract

The tourism sector is a key driver of sustainable economic growth and a major pillar of foreign exchange and regional economic growth. The travel and tourism industry is growing at a rapid pace, adding significantly to the global GDP, creating jobs and promoting stability in the economy. Agrotourism is a key strategy in this growing industry that uses the wealth of nature to highlight regional resources. At the intersection of agriculture and tourism, agrotourism provides a singular setting for cross-cultural learning, rural economic development, and sustainable practices. Agrotourism is based on the fundamental idea of providing a variety of experiences that are both participatory and commercial. It goes beyond simple farm visits and includes a wide range of activities that introduce visitors to rural life. By reducing the risks connected with agriculture, this model helps households diversify their sources of income. In light of this, the current study intends to carefully examine current models, their geographic distribution, common methodologies, and thematic components with the following objectives: 1) To identify the existing Agrotourism Models. 2) To identify the key factors in developing an Agrotourism model. The research utilized the SALSA (Search, Appraisal, Synthesis, and Analysis) framework to examine thirty-two papers that were selected between 2015 and 2023. The outcome demonstrates that Assets, which are made up of a variety of amenities and resources, highlight the functionality and appeal of agrotourism destinations. Tourists are drawn in by attractions, which can be anything from natural features to cultural legacy. Extrinsic and internal motivations have a complex impact on traveler satisfaction and choice. A key factor that drives sustainable growth is stakeholder engagement, where different entities work together. Visitor satisfaction and experience, in addition to marketing and branding, have a big influence on brand loyalty and revisit intentions.

Keywords: *agrotourism, agritourism, models*

T7A-12

Start-up on Insect Protein Amended Animal Feed Production

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Abstract

Insects pose an attractive opportunity to come up with novel sustainable protein source in monogastric animal diets taking into account their nutritive value, biosafety and consumer. With increasing demand in livestock products, challenges have been posed to the existing source of protein in animal feed viz. fishmeal and soybean meal which creates

sustainability concerns. For example, farming soybean can involve deforestation, biodiversity loss, and the use of pesticides whereas fish meal availability is also increasingly limited because of marine overexploitation. Cost of the feed ingredients rapidly increases affecting resource-poor farmers. The search for sustainable alternatives has led to a growing interest in insects as feed component. The urgency to find a sustainable alternative livestock feed ingredient for fishmeal and soymeal has led to market recognition of insect protein as source for animal feeds produced on agricultural food waste. Insect contains high levels of proteins and their production has a small ecological footprint. Among the insect species that are mass reared, the Black Soldier Fly (BSF) have received considerable attention because they can feed on different substrates including organic waste streams. The BSF larvae can feed on different waste streams (organic, raw food waste, manure, slaughter waste) requiring relatively low inputs (space, energy, water) for rearing and can reduce the mass of organic waste by 60% in10 days by converting organic waste to viable feeds and composts at the same time. BSF farming leads to production of sustainable animal feeds which results in increasing production of fish, pig and poultry. Economic upliftment of small holder farmers, reducing land competition between energy and food crops can be achieved which aligns with sustainable development goals (SDGs) (1 & 2). Enhancement of women, youth employment and increased in income from sale of insect as feed component can also be achieved aligning with SDGs (5, 8, 9 &12). BSF farming improves environmental sustainability, improves waste management infrastructure fulfilling SDGs (6, 12, 14 & 15) and is considered as a promising bio-waste treatment option. Therefore, BSF farming recycles resources by feeding on organic waste fulfilling the needs of supplying protein-rich animal feeds as well as production of composted BSF frass which improves crop yield and is a perfect instance pf converting waste into wealth. However, activities like mobilization of farmers to fill the technical gaps and establishing insect rearing among resource-poor farmers is needed to ensure complete facilitation. Therefore, filling the research gap, optimizing and upscaling insect rearing technology, capacity building and partnership in insect production and processing will improve the socio-economic condition of the marginal farmers of our country.

Key words: *BSF larvae, Sustainable development goals, Animal feed, Rural upliftment, Technology dissemination*

T7A-13

Economic Analysis of Production and Marketing of Strawberry in Darechikgre Village, West Garo Hills, Meghalaya

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Abstract

Strawberry, a member of the Rosaceae family, is one of the most economically important berry fruits consumed in the world for its nutrient content and pleasant flavour. In Darechikgre village of West Garo Hills, Meghalaya, under the Department of Agriculture & Farmers' Welfare, Government of Meghalaya, 65 farmers are engaged in Strawberry Cultivation. The present study attempted to examine the economics of production and marketing of strawberry in Darechikgre Village, West Garo Hills, Meghalaya. The study estimated per hectare cost of cultivation of strawberry, the marketing cost, price spread. The study also explored the marketing channels involved in marketing of strawberry. The problems faced by the strawberry growers in production and marketing of strawberry are also documented. The study was based upon the primary data collected from 65 strawberry growers pertaining to the year 2024. Darechikgre village was purposively selected for the study. It was observed that average area under strawberry cultivation per farmer was 0.125 Ha- 0.25 Ha. The major items of marketing cost were grading, packaging material and transportation. The problems faced by the strawberry growers were interference of middleman for the selling of their produce, scarcity of water for irrigation, inadequate quality of soil and high cost of intercultural operations like mulching.

Keywords: *Strawberry, Economics, Production, Marketing*

T7A-14

Production and marketing practices of honey in Chigitchakgre village, West garo hills, Meghalaya

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Abstract

Honey is a natural and almost untreated food produced by bees. It is the sweetest and healthiest natural food. Honey has long been in high demand. Honey is a sweet liquid that honey bees make from plant nectars and other sweet materials by adding their digestive enzymes and ripening the combination that results. The most well-known type of honey produced by honey bees is because of its widespread commercial production and use by humans. The present study attempted to examine the production and marketing practices of honey in Chigitchakgre Village, West Garo Hills, Meghalaya. The study estimated per hives cost, average production, production practices, and methods, and furthermore, the study explores the principles of the marketing mix, also known as the 4Ps, in relation to honey marketing in Chigitchakgre village. 4P's of marketing involved in honey. The study was based on the primary data collected from 25 honey farmers pertaining to the year 2023-2024. The study also explored the distribution channels involved in the marketing of honey. Chigitchakgre village was purposively selected for the study. The major constraint was the lack of marketing practices

followed by farmers. The problems faced by the honey farmers were the deaths of the colony, the the increase in the cost of production, not getting the right price for their produce, and a lack of awareness about the right method.
Keywords: *Production, Honey, Marketing, Methods*

T7A-15

Role of Self help group in Fisheries Resource Management and Fish Production

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Abstract

Fisheries are crucial for food security and economic growth, but face challenges like overfishing and habitat degradation. Self-Help Groups (SHGs) offer a promising avenue for addressing these challenges through collective action. This study investigates the impact of SHGs on fisheries resource management and fish production. Data were gathered through literature review, case studies, and empirical evidence. Literature review focused on SHGs and fisheries management, while case studies provided practical insights. Empirical data, collected through interviews and surveys, assessed SHGs' effectiveness in promoting sustainable fishing practices. SHGs engage in diverse activities including sustainable fishing, habitat restoration, and marketing. Case studies illustrate SHGs' success in enhancing community-led fisheries management and improving social cohesion among fisherfolk. Challenges include limited resources and institutional support, yet with proper interventions, SHGs prove instrumental in sustainable fisheries development. This study underscores SHGs' crucial role in fisheries resource management. Despite challenges, SHGs demonstrate effectiveness in fostering sustainable practices and improving fisher communities' well-being. Supportive policies and capacity-building efforts are essential for maximizing SHGs' potential in achieving sustainable fisheries development.
Keywords: *Self-Help Groups, Fisheries resource management, Fish production*

T7A-16

Ideathon in Agri-allied sectors (Start-up Idea Pitching)

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Abstract

In the past years, the agricultural sector has undergone a transformation, marked by technological advancements, shifting consumer preferences, and global sustainability concerns. In connection with these changes, the emergence of start-ups and entrepreneurial ventures has played a pivotal role in driving innovation and addressing the challenges facing Agri-allied industries. Start-ups in natural dyeing represent a convergence of tradition and innovation, drawing inspiration from age-old practices while leveraging modern technology and scientific advancements to enhance efficiency and scalability. Since textile industry counted as one of the most polluted industries in this world these ventures prioritize the use of botanicals, minerals, and other organic sources to create vibrant and colour-fast dyes, free from the harmful chemicals associated with conventional synthetic dyes. Key elements of start-ups in natural dyeing include research and development initiatives aimed at discovering novel dye sources, optimizing extraction processes, and maximizing colour yields. By collaborating with local farmers, foragers, and artisan communities, these ventures ensure a sustainable and ethically sourced supply chain, thereby fostering economic empowerment and cultural revitalization in rural regions. Start-ups in natural dyeing embrace transparency and traceability, providing consumers with insights into the origins and ecological footprint of their products. Through educational outreach and awareness campaigns, these ventures seek to educate consumers about the environmental and social benefits of choosing natural dyes, thereby fostering a shift towards more conscious consumption patterns. This idea also includes challenges and opportunities facing start-ups in natural dyeing, ranging from raw material sourcing and scalability issues to market penetration and consumer education. By harnessing the power of nature and embracing principles of circularity and resourcefulness, these ventures are poised to redefine the future of the textile industry from hazardous to environmentally friendly.
Keywords: *Advancements, empowerment, entrepreneurial, revitalization, sustainability*

T7A-17

Profile of Occupational health hazards of women workers in the coir industry of Odisha

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Abstract

This research paper aims to investigate the occupational health hazards faced by women workers in the coir industry of Odisha, India. The coir industry, although a significant contributor to the state's economy, often neglects the health and safety concerns of its predominantly female workforce. Through a combination of literature review, field surveys, and

data analysis, this study sheds light on the various physical, chemical, ergonomic, and psychosocial hazards that adversely affect the health and well-being of women workers in this industry. This study explores the profile and socio-economic status of women workers in coir industry in Odisha. The findings highlight the urgent need for better workplace policies, improved safety measures, and increased awareness to ensure the overall health and safety of these workers.

Keywords: *Women workers. Health hazards, musculoskeletal disorders, Socio-economic status*

T7A-18

Improved Box Type Solar Cooker with a Solar-Powered Battery

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Abstract

Solar box type cookers offer a sustainable solution for off-grid cooking, utilizing solar energy to heat and cook food. This paper presents an innovative approach to enhance the efficiencyand usability of traditional solar box cookers through the integration of a solar-powered battery system. The proposed system aims to address the limitations of conventional solar box cookers, such as dependency on sunlight availability and inconsistent cooking performance. By incorporating a solar-powered battery, the cooker can store excess energy during periods of ample sunlight, enabling cooking even in low-light conditions or during night time. Moreover, the battery integration allows for better temperature control and regulation within the cooker, optimizing cooking outcomes and reducing cooking time. The design considerations, technical specifications, and performance evaluation of the improved solar box cooker are discussed, highlighting its potential to provide reliable and sustainable cooking solutions, particularly in areas with limited access to conventional energy sources.This research contributes to the advancement of solar cooking technology, offering a practical and eco-friendly alternative for communities striving for energy independence and resilience.

T7A-19

Integrated Digital Agriculture: The Way Forward

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Abstract

The predictions of the UN Food and Agriculture Organization, there will be an extra 2 billion people on the planet by the year 2050, yet the additional land area used for farming will only make up 4% of the total population at that time, which would lead to a rise in agricultural consumption. There is a pressing need to meet everyone's nutritional needs. In the previously indicated scenario, it is necessary to break through the persistent obstacles in farming and implement more logical growing techniques by leveraging contemporary technology breakthroughs . Artificial intelligence (AI) is the process by which humans construct intelligent machines. The field of computer science focuses on creating intelligent and human-like systems that perform cognitive tasks using logic. The most promising industry is agriculture; yet, it faces several challenges these days, chief among which is a shortage of labor for farming. AI having wide application in horticulture; By this we can detect diseases, enhance the yield, can control the weed, detect the required nutrient to the plant, by this we can control the use of fertilizers . The core components of artificial intelligence are the ability to learn from past experience and make quick, effective judgments. The digital revolution of agriculture and horticulture has significant opportunities for both producers and consumers. The next major agricultural and farming revolution is going to commence with the introduction of digital agriculture.

T7A-20

Rising of Forest Fires in Northeast India: Impacts and Solutions

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Abstract

Forests are the one of the valuable resources and its degradation impact ecological balance and socio-economic fabric of any country in negative direction. One of major cause of forest degradation is forest fire in India. It may be both anthropogenic and natural forest fires. Anthropogenic fires are related to fires that are man-made and it has been estimated that 90% of the fires are caused by human beings. Slash and burn agriculture or shifting cultivation or jhum cultivation is one of the major reasons of forest fire in northeastern region of India. In the last decade it is found that forest fires are the major concern in the north-eastern region which is almost doubled in past ten years. Major impacts due to the forest fire on agrobiodiversity including changes in soil properties and climate change. Under this backdrop there are two objectives i) impacts due to the forest fire on agrobiodiversity including changes in soil properties and climate change. ii) to figure out the modern methods to combat forest fires. Low-intensity fires benefit the fire community, but high-intensity fires cause organic matter loss, NPK volatilization, and alter soil properties. Climate

change and forest fires affect each other. Forest fire indicators for adaptive management include canopy structure, pioneer species, fuel litter, topography data from satellites, weather data, population, and livelihood info. Satellite sensors like MODIS, Landsat, and others assess fires. Both central and local governments, along with national and international institutions, should collaborate to manage forest fires, especially anthropogenic ones, by understanding and supporting forest-dependent communities with training and education.

Keywords: *Forest fire, anthropogenic fire, North East, climate change, satellites*

T7A-21

Catchment Area Assessment: A Critical Socio-economic Analysis for Agricultural Aspects in North-Western Himalayan Region

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Abstract

In the Himalayan region glaciers annual snowfalls feed rivers serving 47% of the world's population. No other region in the world has the comparable number of people, scarcity of rainfall, dependence on agriculture, tempting sites for mega-projects and vulnerability to climate change. Being a part of north-western Himalayan region, the catchment development Block has has 31632 ha area owned by the farmers on which various Horticultural, Agricultural including Vegetable Cultivation and Animal Husbandry activities are carried out. The main objective of this study was survey of vegetable, horticultural, agricultural crops in specific block of Himalayan region. The status of these activities as revealed by the survey is summarized that the predominant fruit crops comprised of Apple, Plum, Pear, Pomegranate, pecnut, Apricot, Almond, Persimmon and Walnut. The Block has 15748 hectare area on which various cereal and vegetable crops are grown. Among the cereal crops, Maize dominates during Kharif season whereas Wheat and Barley are the main crops during Rabi season. Rajmash and Urd are also grown during the kharif season. The most preferred vegetable crops are Tomato, Peas, Garlic, Cauliflower, Potato and Cabbage. Keeping in viewfrom the complete analysis done so far the following recommendation may be made of an additional area may be brought under irrigation as well as from the area under field crops, efforts may be made to bring some area under fruit crops. Where ever agriculture is done on sloppy lands, bench terracing should be done and Water harvesting structures may be raised simultaneously some cultivated area be put under fodder cultivation. A financial outlay of Rs.3099.63 is recommended to implement these recommendations in bare minimum of 1 % area owned by the farmers in the entire catchment.

Keywords: *Agriculture, Horticulture, Watershed, Fruits, Vegetable Crops, Himalayan Region.*

T7A-22

IoT (Internet of Things) in Entomology

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Abstract

The IoT (Internet of things) has revolutionized not just how we live but also how we operate .The adoption of IoT is growing quickly across many industries, whether it be agricultural, safety, or healthcare. IoT with robotics and artificial intelligence have increased the complexity of commercial farms while reducing manual works up to a great percentage. Researches conducted earlier has examined the application of contemporary methods in the agricultural industry, including IoT, sensors, cloud services, mobile computing, and big data analysis. Currently, it is found that, all over the world, around 50% of the farm produce never reaches the end consumer due to wastage. A major role has been known to be played by the insect pest and diseases that reduce the yield drastically. Mobile applications and the internet are among the best options for bringing IPM technology to farmers of all skill levels. For example, IoT-based automated traps (Semios, Spensa) allow us to capture, count, and even characterize insects, which can upload more data to the Cloud for further analysis. This cannot be done with remote sensing. The insect pests hamper the health of the plant, reduce the biomass, and hence, productivity and production. However, this requires continuous monitoring of experts which might be extremely expensive in large farms. Further, in some developing countries, farmers face many hurdles even in reaching the experts, thus making the process too expensive and time-consuming. Therefore, in today's modern era, automatic detection and recognition of insect pests is the need of the hour to automatically detect the symptoms caused by a particular insect pest as soon as they appear on plant parts.

Keywords: *IoT, robotics, automated, artificial intelligence, detection*.

T7A-23

Information utilisation pattern of fish farmers through a mobile-based agro advisory (Matsya Varta) in Tripura, India

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Abstract

Information is vital for fisheries development, increasing production, refining distribution, and enhancing marketing. Its value is maximised when timely and effectively utilised, improving fish farming efficiency. In the digital era, Information and Communication Technology (ICT), particularly mobile phones, plays a crucial role in disseminating information to extension agencies and fish farmers. In Tripura, the College of Fisheries employed a farmer-centric ICT-mediated extension approach, 'Mobile-based Agro-advisory System in Tripura (Matsya Varta)', to provide real-time information to empower fish farmers. This present study assessed the efficacy of this system among 120 randomly selected registered fish farmers of Matsya Varta from four districts of Tripura, India. Data analysis included frequency, mean, standard deviation, Kruskal-Wallis tests, and logistic regressions. Key areas of interest of respondents found pond management, fish feed, and disease management. The results indicated that the respondents accessed information aligned with their needs, primarily via live interaction and text messages. The respondents utilised information on pond management to the greatest extent as they highly needed and accessed information on pond management. The respondents utilised most of the information on disease management frequently, which shows the importance and value of information on fish disease management through a mobile-based agro advisory system (MBAS). No significant differences were found among districts in information utilisation. Multiple stepwise logistic forward regressions analysis identified socioeconomic factors, age, caste, family type, economic motivation, and achievement motivation influencing information utilisation. Engaging 'Field Coordinators to assist farmers in accessing governmental support is recommended. Improvements are also suggested in information timeliness and comprehensiveness. Customisation is deemed necessary to enhance the usefulness and credibility of advisories for farmers.

Keywords: *Mobile-based agro advisory system, Information utilisation, Information timeliness, Fish Farmers*

T7A-24

Assessment of Emotional Intelligence of Students: A case from Agricultural Colleges of Ri-Bhoi District, Meghalaya

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Abstract

In the era of artificial intelligence, emotional Intelligence (EI) is a valuable human quality, as it shapes personal, academic, and professional success by enabling individuals to perceive, access, and regulate emotions. Integral in education, it fosters academic achievement, mental health, workplace competence, and overall life success. Researching emotional intelligence in agriculture students examines how emotions affect academic and future career performance, teamwork, leadership, and stress management. This understanding can lead to practical programs to improve their emotional skills, making them better prepared and resilient professionals in agriculture. Under this backdrop the present study was conducted to assess the Emotional Intelligence level of agriculture students with the following objective i) To assess the current Emotional Intelligence levels of Agricultural Students ii) To compare Emotional Intelligence level between different group of students. The locale of the study College of Post Graduate Studies in Agricultural Sciences and College of Agriculture, Kyrdemkulai. It is an observational, survey-based study. EI was assessed using Schutte Self Report Emotional Intelligence Test (SSEIT). SSEIT was distributed to 280 students after informed consent. Students had to respond on a five-point Likert's scale. The data obtained were interpreted using descriptive statistics and analyzed with SPSS. The study's findings indicate that a minority, specifically 25% of students, exhibit a low level of emotional intelligence. Notably, there is a noteworthy gender disparity, with male respondents demonstrating a higher level of emotional intelligence compared to their female counterparts. Interestingly, no significant differences in emotional intelligence were observed among students from different schools within the college. Additionally, the residential area did not emerge as a determining factor, indicating that emotional intelligence levels were consistent across various residential backgrounds. Training modules can be incorporated in graduate education programmed to improve EI.

Keywords: *Emotional Intelligence, Agriculture Students, Schutte Self Report Emotional Intelligence Test* (SSEIT).

T7A-25

IoT Applications in Urban Vertical NFT Hydroponic Farming Systems

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Abstract

The use of Internet of Things (IoT) technology within the agricultural sector has garnered significant interest in the recent years. Researchers have acknowledged the capabilities of IoT in enhancing diverse agricultural methodologies, such as hydroponic vertical farming.Vertical hydroponic farming represents a modern farming method enabling plant cultivation within a regulated setting devoid of soil. This approach optimizes restricted space and resources, rendering it particularly suitable for urban settings or areas with limited arable land. The integration of Internet of Things (IoT) technology into vertical hydroponic farming systems presents a variety of benefits, including the ability to monitor environmental conditions in real-time, automate the management of nutrients and water, enable remote access and control, and facilitate data-driven decision-making. Utilizing IoT technology enables urban farmers to oversee and regulate their hydroponic vertical farming systems remotely through interconnected devices. They can receive updates and alerts about the temperature, humidity, pH levels, nutrient levels, and other important parameters of their plants. This enables them to make adjustments and optimize the growing conditions for maximum plant growth and productivity. Furthermore, IoT technology enables the automation of various tasks, such as the provision of supply of nutrients and water, thus eliminating the need for manual intervention and reducing occurrences of human error. Overall, the application of IoT technology in NFT hydroponic vertical farming systems enhances efficiency, productivity, and sustainability. Additionally, it provides valuable data and insights that can be used for research and development purposes, improving future farming practices. By harnessing the power of IoT in NFT hydroponic vertical farming systems, farmers can revolutionize the way they grow crops.

Keywords: *Hydroponic, Internet of Things, Vertical Farming, Automation, Nutrient Film Technique*

T7A-26

Unlocking AI Generative Image Innovative Potential for Agriculture: The Case of DALL·E

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Abstract

Artificial Intelligence (AI) technology is developing at a rapid pace, causing revolutionary changes in many different industries. Technology is always evolving, giving rise to new cultures and educational approaches. This paper explores the potential applications and future implications of DALL·E, an AI model capable of generating diverse and contextually relevant images from textual prompts, in the field of agriculture. As the global population continues to grow and environmental challenges escalate, there is an urgent need for innovative solutions to enhance agricultural productivity, sustainability, and resilience. DALL·E's ability to generate custom images based on textual descriptions opens up new avenues for agricultural research, development, and communication. This study examines the ways in which DALL·E can be leveraged to visualize complex agricultural concepts as DALL·E can transform textual descriptors into realistic visual content and has the potential to facilitate communication, decision-making and knowledge transfer among stakeholders within the agricultural community. Furthermore, the integration of DALL·E with other AI technologies, such as machine learning and computer vision, holds promise for optimizing agricultural processes, from crop monitoring to yield prediction. Through a combination of literature review, this research sheds light on the potential benefits and challenges associated with integrating DALL·E into agricultural practices. Ethical considerations, including data privacy and bias in image generation are also addressed to ensure responsible deployment of AI in agriculture. By envisioning the future implications of DALL·E in agriculture, this paper aims to inspire interdisciplinary collaboration and innovation towards a more sustainable and resilient food system.

Keywords: *Artificial Intelligence, DALL·E, Machine learning, Sustainability*

पशुचिकित्साएवंपशुपालनबिज्ञानमहाविद्यालय ,केंद्रीयकृषिविश्वविद्यालय,

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3. 75 students from 3 batches successfully graduated
4. Many villages adopted in Peren districts
5. Multiple trainings conducted /multiple technologies transferred

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- Focuses on increase animal productions and their welfare

Extension Activities

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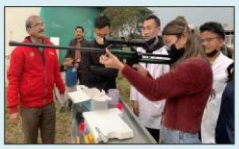

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COLLEGE OF HORTICULTURE
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About the college

The College of Horticulture is a constituent college of Central Agricultural University, Imphal located at Thenzawl town in heart of the Mizoram since 18th June 2016. The college is 90km away from Aizawl, the capital of the state. Thenzawl is popular for best tourist places and hub of the handloom centers in Mizoram.

The mission of the college is to develop highly trained human resources to serve the farmers, as an entrepreneur and in turn, to the nation. Besides curriculum, it also focuses on overall development of students' personality and career.

Program: B.Sc (Hons.) Horticulture
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Intake Capacity: 32 nos.
Course Duration: 4 Years

- ✓ Well equipped smart classrooms, laboratories and research farms
- ✓ Experienced and well trained teachers
- ✓ Hostel facilities for Boys and Girls
- ✓ Good library, sport and gym facilities




Contact address: Dr. Shri Dhar, Dean email: dean_cohmz@yahoo.com

Prof. Indira Sarangthem
Dean

COLLEGE OF AGRICULTURE

CENTRAL AGRICULTURAL UNIVERSITY, IROISEMBA, IMPHAL

Email: dean_collegeagri@yahoo.co.in

The College of Agriculture (COA), Iroisemba, was established as the first constituent College of Central Agricultural University, Imphal after taking over the erstwhile Manipur Agricultural College under Manipur University in November, 1993. The College is situated in an extensive area of Iroisemba, at a distance of about 5.0 km from Imphal city. The picturesque campus of the College, covering an area of about 44 acres of land is surrounded by Langol Hillocks to its Western and Northern sides.

Courses Offered

Graduation		Seats	Duration
Under graduate	B.Sc. (Hons.) Agriculture	117	4 years
Post graduate	M.Sc. Agriculture/Horticulture	61	2 years
Doctorate	Ph.D. Agriculture	13	3 years

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- Paddy variety CAU-R3 (Mangalphou)
- Paddy variety CAU-R4 (Eenotphou)
- CAU Umangra-1 (variety of Cassava)

Extension

- Awarenes programe on package of practices of crop.
- Hand on training/transfer of technology

Extra-curricular activities

Games & Sport/Literary & Cultural/All India educational tour/councelling/motivational talks/skill development/ NSS/National Days Observation

Significant achievement

"Transferring Wetland to Farming land in Manipur" begged the "Best Institutional Film – SAU" award during the MANAGE Award Ceremony 2024 at MANAGE, Hyderabad on 22nd February, 2024 for transformation of approx. 15 ha. of wetland in Central farm, CAU, Lamphelpat into cultivable land



Courses offered:

- **B. Sc. Horticulture (Hons.)**
- **B. Sc Forestry (Hons.)**
- **M.Sc Horticulture (Vegetable Science)**
- **M.Sc Horticulture (Fruit Science)**
- **M.Sc Horticulture (Floriculture & Landscape Architecture)**
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- **Ph. D Horticulture (Fruit Science)**







College of Horticulture and Forestry
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COLLEGE OF FISHERIES

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Pre-Seed Stage Startups 115
Seed Stage Startups 17
Total 132
₹ 1.48 Cr. Grant in-Aids approved so far!
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cof_incubator
CoF Incubator
R-ABI COF CAU-I
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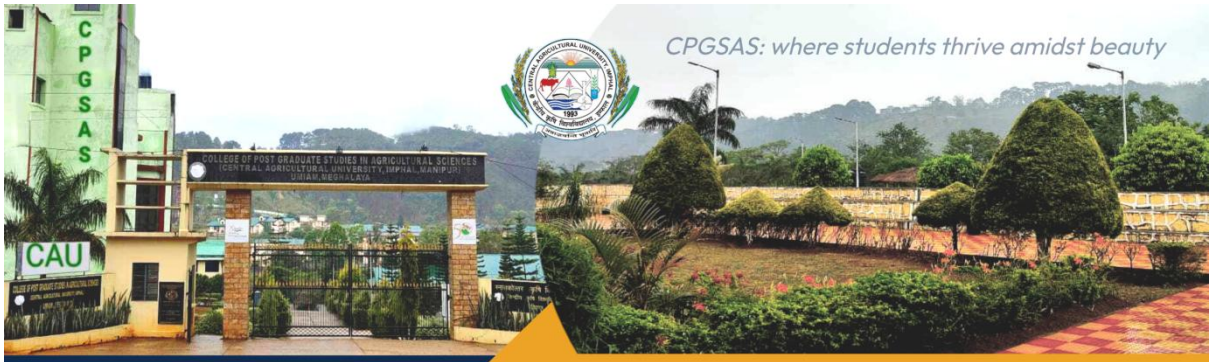

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College of Post Graduate Studies In Agricultural Sciences, Central Agricultural University(I), Umaim

About Us

CPGSAS excels in fostering excellence across 10 specialized disciplines within agricultural sciences. Dedicated to cultivate proficient postgraduates nationwide, empowering them to spearhead agricultural advancement and bolster farming communities. With unwavering dedication, our scholars are adept at pioneering advanced research, adeptly operating cutting-edge research instruments, and gaining invaluable hands-on experience in hill and mountain agricultural ecosytem.

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College of Post Graduate Studies in Agricultural Sciences, Central Agricultural University (Imphal), Umroi Road, Umiam, Ri Bhoi, Meghalaya 793103

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COLLEGE OF COMMUNITY SCIENCE
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Courses Offered

- B.Sc. (Hons.) Community Science
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- M.Sc. (Extension Education and Communication Management)
- M.Sc. (Food and Nutrition)

ABOUT US

The College of Community Science (erstwhile Home Science) was established in 1997 and started on September, 2004. The College is situated in Sangsanggre at a distance of about 3 km from Tura town, West Garo Hills, Meghalaya. The College is bestowed upon by the breathtaking sceneries. Community Science is a multi-disciplinary subject preparing graduates to address critical challenges with the intersection of science and soceity especially in the North Eastern States.

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- Extension Edu. & Communication Management,
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- Hostel Facility

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- Capacity Building Programs

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- ICAR-JRF Examination: 1st Rank in 2009, 2010, 2019 / 2nd Rank in 2011, /3rd Rank in 2014 / 12th in 2023
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- Entrepreneurs

ACHIEVEMENTS IN RESEARCH

- **Ergonomics and Drudgery Reduction**
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COLLEGE OF AGRICULTURE
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KYRDEMKULAI-793105, RI-BHOI, MEGHALAYA

The College of Agriculture (CoA), Kyrdemkulai, Meghalaya is a constituent college of Central Agricultural University, Imphal, Manipur located at Kyrdemkulai village, Ri-Bhoi District, Meghalaya. The college campus is spread over an area of 226 acres covered with forest areas, hilly terrain and sloppy lands. The college is 38 km away from Shillong, and about 78 km from Guwahati, Assam

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- **Student Foreign Exchange Training Programme**
- **Experiential Learning Programme**
- **Separate hostel for Boys and Girls**
- **Medical Unit**
- **Merit Scholarship (100%)**
- **Games (Indoor/Outdoor) and Sports**

Courses Offered: B.Sc., (Hons.)

Degree (4 years)	Seats alloted
Agriculture	41
Natural Farming	50

Passed out students qualified ICAR-AIEEA (PG) pursuing post-graduation in reputed institutions

Research Achievements:

- 03 externally funded project
- AICRP on Maize

Extension:

- Front Line Demonstrations
- Technology Transfer
- Training and Awareness programmes

Significant Achievements:

- **First college among the CAU to offer and commence B.Sc., (Hons.) Natural Farming course.**
- **B.Sc., (Agri) students (05 nos.) of CoA-K had undergone Foreign Training Programme at International Universities under IDP-NAHEP**
- **The college developed Agro-EcoTourism Park having traditional Khasi Huts, Tree House, Gazebos and Bridges with rich bio-diversity.**
- **Students of CoA, Kyrdemkulai bagged 2nd Runner up position in 8th Inter-Collegiate Youth Festival**

Career counselling

31 Students qualified JRF

5 batches passed out

Prof. N S Chauhan
DEAN

COLLEGE OF AGRICULTURAL ENGINEERING AND POST HARVEST TECHNOLOGY

CENTRAL AGRICULTURAL UNIVERSITY, RANIPOOL, GANGTOK, SIKKIM.

Email: caepht.dean@gmail.com; dean-caepht@gov.in

The College of Agricultural Engineering and Post Harvest Technology (CAEPHT) was established by Central Agricultural University in the year 2006 to address the issue of shortage of trained manpower (human resource) in the disciplines of agricultural engineering and post harvest technology besides other issues, pertaining to natural resource management, farm mechanization, post-harvest technology, processing & value addition, utilization of renewable sources of energy, creation of agro-industries etc. in the region.

Courses Offered

Degree	Course	Seats	Duration
Under Graduate	B. Tech Agricultural Engineering	58	4 years
	B. Tech Food technology	22	
Post Graduate	M. Tech (Agricultural Engineering) FMPE/ SWCE/PFE/IDE/REE	20	2 years
Doctoral	Ph.D. (Agricultural Engineering) FMPE/ SWCE/PFE/IDE/REE	8	3 years

Research Achievements

Particulars	Nos.	Titles of work
Patents	2	• A device for measuring the discharge rate yield of a stream • Multi column sand filter and a method thereof
Design Patents / Registrations	5	• Biomass Cookstove • Top and Front Fed Biomass Cookstove • Top Fed Biomass Cookstove • Fog Harvester • Gravityfed Drip Cum Fertigation System
Copyrights	2	• Gravity Driven Drip Irrigation Solutions for Hilly Region • Development of Python Codes For Innovative Trend Analysis

Extension Achievements

- Organization of various farmers trainings, workshops, Kisan fairs
- Empowerment of the agriculture farmers by providing right information at right time through mobile based agro advisory system through Jaivik Varta M4Agri

Highlights of College

- Well qualified faculties from across the country
- Well equipped 06 departments and laboratories
- Training placement cell, Student/faculty foreign training programmes
- 100% Hostel facility
- Merit Scholarship
- Admission to foreign students
- Smart Classrooms / Virtual Classrooms/ computer Laboratory/ Library facility / Seminar and Conference halls
- Coaching for ICAR SRF/JRF/ARS and Gate examinations

Extra Curricular Activities

Games & Sports / Literary and cultural activities/ All India Educational Tour/ NSS / study Tours/ Motivational Lectures/ Skill based Student Trainings / Foreign Language trainings

Location of College

- The College of Agricultural Engineering and Post Harvest Technology (CAEPHT) is situated at Ranipool, Gangtok on National Highway -10 (NH 10) connecting Siliguri in West Bengal to Gangtok, the capital of Sikkim State.
- The nearest broad gauge railway station is New Jalpaiguri(NJP), about 120 kms away while the nearest airport is Pakyong 18 km from location while other airport is Bagdogra in Darjeeling District at about 124 Km distance.

COLLEGE OF HORTICULTURE

CENTRAL AGRICULTURAL UNIVERSITY, IMPHAL

BERMIOK, SOUTH SIKKIM

College of Horticulture, Bermiok, Sikkim was established on 21st May 2015 which falls under the beautiful landscape of Namchi Block of South Sikkim. The state itself falls under one of the biodiversity hotspots, the eastern Himalayas which are bestowed with beautiful landscape with rich diversity of variant species of flora and fauna. It is situated in the Southern mountain ranges of the Eastern Himalayas between Northern Latitudes 27 ° 4′45″ to 28 ° 7′ 45N latitudes ″ and 88 ° 45″ to 88 ° 35′ 15″ E longitudes. The state enjoyed varied agro-climatic zones ranging from sub-tropical in the lower valley to alpine in the upper ranges. It is the home of many orchid species.

Programme running: B.Sc. (*Hons.*) Horticulture.
Accredited by Indian Council of Agricultural Research, New Delhi
Facilities:
1. Playground
2. Students' Reserch Farm
3. Good Laboratory facilities etc.

For admission kindly go to www. cau.ac.in


CENTRAL AGRICULTURAL UNIVERSITY, IMPHAL
केंद्रीय कृषि विश्वविद्यालय, इम्फाल
1993
अन्नाद्भवन्ति भूतानि
ADMINISTRATIVE AND ACADEMIC BUILDING
Sailent Achievements
COLLEGE OF AGRICULTURE PASIGHAT
TEACHING
The college offers 4years B.Sc.Agri degree programme, and 2 years PG programme in two disciplines.
Our 23 students were placed in different state Govt. jobs till now.
RESEARCH
CoAP has 19 running projects viz. EFRP-4(completed 1), IRP-2, NEH-5, AICRP-2, Others-6 (Consultancy Project), during 2023-24.
Potato varieties Kufri Lalima, Kufri Pushkar and Kufri Khyati recommended for the foot hill condition of Arunachal Pradesh, under AICRP Potato
New Crops introduced: Groundnut, Small millets for the farmers of the state.
40 accessions of Acorus calamus was recorded (IC-0632778 to IC-0632817). Evaluation of Accessions for oil-yield- IC-0632792 (1.4%) , IC-0632808 (1.8%), IC-0632810 (1.5%) performed well for oil yield against check (1.3%).
EXTENSION
The college organised Kisan melas-1, Agri Fairs-2, Workshops-03 and Millet walkathon to disseminate the technology, create mass awareness on agricultural technologies.
Conducted 100 plus FLDs on various topics -improved and high yielding varieties in Rice. Millets, Maize, Pulses and Oilseeds, Mushroom, Beekeeping etc. covered 50hactares of cultivated area in the state.
It is one of the best Agriculture college campus under the umbrella of Central Agricultural University, Imphal
The campus of the college is based in Pasighat, Arunachal Pradesh. A lush green area spread in 86 acres on the bank of mighty river Siang. The college is very well equipped and there are several other facilities that are provided to the students which include a Cafeteria,Hostels, Smart Classrooms, well equipped Laboratories, CCTV surveillance and Wi-Fi internet and other such amenities for the students and faculties.
NEW INITIATIVES
5G TRAINNG LAB
HONEBEE TESTING LAB-
AGRO ECO-TOURISM
DIGITAL DESIGN AND 3D PRINTING TRAINING LAB
DEVELOPMENT OF SATELLITE VILLAGE
5G TRAINING LAB
HONEY BEE TESTING
SMART CLASSROOMS
LABORATORY
FIELD HANDS ON ACTIVITIES
MILLETS INTERVENTION
ELP ON MUSHROOM
FLDS AT FARM
+91-9436108690
cau.coapasigha@yahoo.com

Prof. L Hmar
Dean

COLLEGE OF VETERINARY SCIENCES AND ANIMAL HUSBANDRY, SELESIH, AIZAWL

Constituent College of Central Agricultural University, Imphal

The College of Veterinary Sciences & Animal Husbandry, one of the constituent Colleges of the Central Agricultural University was established through the promulgation of an Ordinance (No.M-2 of 1995; dated 20th February 1995) and became functional with the admission of first batch of students to B.V.Sc. & A.H. degree programme in the year 1997.

The Campus of the College is spread over 168.61 acres of land, mostly hilly terrain at an altitude of 965 meters above the mean sea level. The jurisdiction of the College extends to different North Eastern States comprising of the States of Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Tripura, Nagaland and Sikkim.

Mandate

- To impart education in different branches of Veterinary Sciences & Animal Husbandry
- To further the advancement of learning and prosecution of research on Veterinary Sciences & Animal Husbandry
- To undertake programmes of extension education in the states under jurisdiction, and
- To undertake such other activities in the fields of Veterinary Sciences & Animal Husbandry as it may deem fit from time to time.

Key Features

- Well-qualified facilities from across the country
- We equipped 17(seventeen) teaching Departments including the Teaching Veterinary Clinical Complex (TVCC) and Instruction Livestock Farm (ILFC)
- Good library facility with also accessible to around 2000 national and international e-journals through an e-journal consortium
- Central Lecture Halls Block consisting of 6 Lecture Halls with seating capacity of 60 students each
- Hostel Facility for Girls and boys with a separate library
- Good internet connectivity in campus

Location

- The College is located at Selesih, North of Aizawl 12 kilometers away from Aizawl, the capital city of Mizoram on the Aizawl-Sihphir-Silchar state highway.

Prof. Ng. Iboyaima Singh
Dean

COLLEGE OF FOOD TECHNOLOGY

CENTRAL AGRICULTURAL UNIVERSITY, LAMPHELPAT, IMPHAL

Email: dean.coftimf@gmail.com

College of Food Technology, Lamphelpat is one of the 13 constituent colleges of the Central Agricultural University, Imphal. Located presently at about 7 kms. from Imphal City at the lush green foothills of Langol Hills in Imphal West District, the college was established on 2nd of December 2014 under the jurisdiction of the Central Agricultural University, Imphal. The present campus of the college spreads over an approximate area of about 33 acres comprising of Administrative cum Academic building, Boys' and Girls' Hostels, flood lighted outdoor playground, a cold storage unit, a liquid biofertilizer production unit, a food processing Pilot Plant as well as cultivable farm land. The campus lies adjacent to the Central Farm of the Central Agricultural University with variety of cultivation and animal husbandry activities, traditional livelihood heritage models of the seven NE states, a food museum housing the famous foods of the NE states.

Course Offered

Graduation		Seats	Duration
Under graduate	B.Tech. Food Technology	32	4 years

Registration Certificate
Government of Manipur
Department
(Food Safety and Standards Enforcement Wing)
Food Safety and Standards Authority of India
Registration Certificate under FSS Act, 2006

Extension Activities

- Hands on training/transfer of technology.
- Training Programmes sponsored by APEDA, CIPHET, State Govt. (MOMA), etc.
- Outsourcing of Pilot Plant to Local Entrepreneurs.
- Adopted Village.
- Regular Health Camps at Orphanages, Relief Camps etc.

Extra-curricular activities

Games & Sport/Literary & Cultural/All India educational tour/counselling/motivational talks/skill development/NSS/National Days Observation.

Significant Achievements

- North East Food Museum established in 2024.
- Food Processing Pilot Plant running successfully in 2023.
- Instant *Chak-Hao* Kheer Mix formulated and commercialized successfully on 2022.
- Declaration of *Chak-Hao* as Super Food on 21st July, 2024 by the Dean.
- Creation of Food testing lab for Local Commercial samples.
- Extension publications including Food Atlas of Manipur, Manual on proximate analysis of food.

Research Achievements

- Fruits and Vegetable Harvester.
- Biomass Heat Generated Dryer.
- Makhana harvester.
- Pineapple Harvester.
- Rhizome Washer.

- Well qualified faculties from across the country
- Well equipped 5 departments
- 100% hostel availability
- Merit scholarship
- Smart Classroom/Virtual Classroom/Computer Laboratory

DIRECTORATE OF EXTENSION EDUCATION
Central Agricultural University, Imphal

Prof. Ph. Ranjit Sharma
Director

The Directorate of Extension Education is responsible for the dissemination of useful and latest agricultural information to the farmers through constituent colleges and Krishi Vigyan Kendras of the University besides planning, monitoring, and executing extension progress based on results of the research conducted in all campuses/units of the University. Directorate of Extension Education, Central Agricultural University, Imphal deals with front-line activities to disseminate agricultural know-how and emphasizes getting acquainted with the technologies among the farming communities

Vision

Self-reliant, healthy rural populous with rich agricultural knowledge and good marketing intelligence.

Our KVKs

KVK, South Hills, Meghalaya:
Year of Establishment: 2017

KVK, Sephajala, Tripura:
Year of Establishment: 2018

KVK, Imphal East, Manipur:
Year of Establishment: 2005

KVK, KVK, East Siang, Pasighat:
Year of Establishment : 2006

KVK, East Garo Hills, Meghalaya:
Year of Establishment: 2017

KVK, Aizawl, Selesih, Mizoram:
Year of Establishment: 2005

Different Activities

AICRP on Maize

COLLEGE OF AGRICULTURE

(CENTRAL AGRICULTURAL UNIVERSITY)

KYRDEMKULAI-793105, RI-BHOI, MEGHALAYA

All India Coordinated Research Project (AICRP) on Maize was started with the basic objective to develop and disseminate superior cultivars and production/protection technologies across maize growing regions of the country. AICRP organizes multidisciplinary, inter-institutional systematic testing of newly developed cultivars from both private and public sectors. In addition, it also develops production and/or protection technologies for the located zones of the country.

Mandate of AICRP on Maize:

- **Develop superior hybrids and varieties combining high yield and acceptable quality of grain and fodder, wider adaptability and resistance to major pests, diseases and abiotic stress factors for the zone**
- **Evolve appropriate crop management practices and formulate efficient maize-based cropping systems for sustainable maize production in the zone**
- **Conduct investigations on key or potential pests and diseases of maize and identify and evolve elite sources of resistance to develop suitable integrated plant protection strategies for increasing the stability of production**
- **Promote research & extension to meet local needs within each state through SAUs & other partners**

Extension:

- Front Line Demonstrations, Technology Transfer, Training and Awareness programmes



Research Achievements:



Significance Achievement:

1. Testing of maize hybrid entries for early & medium duration in AICRP trials for specialty as well as for field corn
High yielding outperforming accessions to the check of field and specialty corn suitable for NHZ were identified and reported
2. Exploration, identification and maintenance of genetic resources of maize from NE and across the country for field corn, specialty corn & pigmented corn
250 maize landraces including pigmented maize available and maintained collected from the entire North East Hill Region
3. Identification and development of maize inbred lines from local landraces/ germplasm of field and pigmented corn suitable for NEH region
Selfing of landraces started to develop Inbreds for field as well as for pigmented maize




Poster launch ceremony of Agrivision 2024









Agrivision
A forum of Agriculture Students