



IXth International Conference in
Hybrid Mode on

Global Research Initiatives for Sustainable Agriculture & Allied Sciences

10-12 DECEMBER 2024

Souvenir & Conference Book (GRISAAS-2024)

Chief Editor

Dr. S.P. Singh



Organized by :

Astha Foundation, Meerut (U.P.) India



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Karnataka, INDIA



SSDAT
Meerut (UP) INDIA

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**IXth International Conference in Hybrid Mode on
GLOBAL RESEARCH INITIATIVES FOR
SUSTAINABLE AGRICULTURE & ALLIED SCIENCES
(GRISAAS-2024)**

10-12 DECEMBER 2024

Organized By

Astha Foundation, Meerut (U.P.) INDIA

In Collaboration with

Sri Karan Narendra Agriculture University, Johner, Rajasthan, India

University of Agricultural Sciences, Raichur, Karnataka, India

Swami Keshwanand Rajasthan Agricultural University, Bikaner, Rajasthan, India

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(GRISAAS-2024)**

SOUVENIR & CONFERENCE BOOK

Chief Editor

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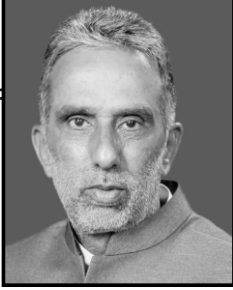
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कृष्ण पाल गुर्जर
Krishan Pal Gurjar



सहकारिता राज्य मंत्री
भारत सरकार
MINISTER OF STATE FOR
CORPORATION
GOVERNMENT OF INDIA



MESSAGE

It is a great to welcome you all to the **IXth International Conference in Hybrid Mode on Global Research Initiatives for Sustainable Agriculture and Allied Sciences (GRISAAS-2024)** which is being held during 10-12 December 2024 Organized by Astha Foundation, Meerut in collaboration with SKNAU, Jobner, Rajasthan; CSAUAT, Kanpur, U.P.; UAS, Raichur, Karnataka; SKRAU, Bikaner, Rajasthan; AU, Jodhpur, Rajasthan; KSNUAHS, Shivamogga, Karnataka; HPU, Shimla, H.P.; ICAR-CIFE, Mumbai, Maharashtra; JNU, Jaipur, Rajasthan; AFU, Rampur, Chitwan, Nepal and Society for Scientific Development in Agriculture and Technology, Meerut (UP) India, during 10-12 December, 2024.

India has undergone a series of ups and down in agriculture production and food security playing havoc in the year of abnormality. Food Security in India can be achieved by playing higher attention to such as climate change, integrated water management, use the advanced agricultural techniques and pricing etc. New technologies will be make it possible for sustainable agriculture.

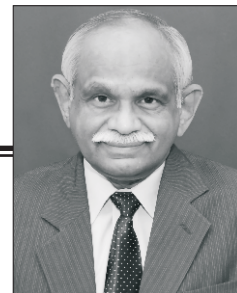
I express my sincere thanks to the organizers for organize such kinds of International Conference to exchange the idea for the growth of Agriculture.

Krishan Pal Gurjar



National Academy of Agricultural Sciences

Prof. Anil Kumar Singh
Vice-President



MESSAGE

It is a matter of great pleasure to know that **Astha Foundation, Meerut** in collaboration with SKNAU, Jobner, Rajasthan; CSAUAT, Kanpur, U.P.; UAS, Raichur, Karnataka; SKRAU, Bikaner, Rajasthan; AU, Jodhpur, Rajasthan; KSNUAHS, Shivamogga, Karnataka; HPU, Shimla, H.P.; ICAR-CIFE, Mumbai, Maharashtra; JNU, Jaipur, Rajasthan; AFU, Rampur, Chitwan, Nepal and Society for Scientific Development in Agriculture and Technology, Meerut (UP) India, are organizing a three days IXth International Conference in Hybrid Mode on “**Global Research Initiatives for Sustainable Agriculture & Allied Sciences (GRISAAS-2024)**” during 10–12 December, 2024.

Agriculture is no longer an activity for subsistence only it has to be considered as a commercial enterprise in which profitability and sustainability are both equally vital. Farming has to be technology driven with a clear cut focus on reducing cost of cultivation and enhancing productivity and quality of produce. It has to be knowledge based. Without application of science and technology in agriculture and allied fields, the sustainability would remain uncertain considering the challenges being faced by the Agriculture sector worsen by the climate change impacts. It requires a multi- pronged approach to manage natural resources sustainably, enhanced productivity link the production system to storage, processing & value addition and marketing in order to make the entire system, vibrant and employment oriented. I feel that in this conference, the learned delegates will deliberate on burning issues and challenges facing the farming community with emphasis on small and marginal farmers and come out with tangible suggestions. I hope that the outcome of the Conference will help in developing strategies and an action oriented road map to promote sustainable and profitable agriculture.

I wish the conference a grand success and congratulate the organizers for their judicious planning and hard work in making this kind of academic interface.


(A.K.Singh)



VICE CHANCELLOR SECRETARIAT
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Prof. Bal Raj Singh
Vice Chancellor
S.K.N. Agriculture University
Jobner, Jaipur, Rajasthan



Date :

Ref. No. :

MESSAGE

Innovations can only have the answers to plateauing yield stagnation in crop productivity levels. With Challenges in several fronts as reduced land availability and increased demand for food production, crop production is being intensified through higher fertilizer inputs and cropping. The increase in production has to be achieved under conditions of declining and deteriorating land, soil and water resources and at the same time preserving the environmental quality. It will be indeed difficult to meet these daunting challenges only with the application of conventional techniques and tools, as no headway is being made through these approaches. To address the emerging challenges opportunities have to be identified to meet crop production and productivity targets so that the novel variability can be created and harnessed across the species and kingdoms. It is in this context, the three days IXth International Conference in Hybrid Mode on “Global Research Initiatives for Sustainable Agriculture & Allied Sciences (GRISAAS-2024)” organized by Astha Foundation, Meerut (U.P.) in collaboration with SKNAU, Jobner, Rajasthan; CSAUAT, Kanpur, U.P.; UAS, Raichur, Karnataka; KSNUAHS, Shivamogga, Karnataka; HPU, Shimla, H.P.; AFU, Rampur Chitwan, Nepal; ICAR-CIFE, Mumbai, Maharashtra and Society for Scientific Development in Agriculture and Technology, Meerut (U.P.) during 10–12 December, 2024.

The conference will provide a common platform for all the stake holders to share their Innovations/experiences and expertise to better understand the challenges posed by emerging problems in agriculture and to fine-tune future strategies/approaches for addressing such stresses in different areas of agriculture and allied sciences. I convey my greetings and best wishes to organizers and delegates for their joint venture for the success of these three days International Conference in hybrid mode.

(Prof. Bal Raj Singh)



पतंजलि विश्वविद्यालय UNIVERSITY OF PATANJALI

Patanjali Yog Peeth, Roorkee-Haridwar Road, Haridwar, Uttarakhand 249405

Dr. Jeet Singh Sandhu

Professor Chair,
Guru Gobind Singh Chair, Patanjali
University, Uttarakhand
Former VC, SKNAU, Jobner
Former DDG (Crop Science), ICAR
Former Agric. Commissioner, GoI, New Delhi



Date :

Ref. No. :

MESSAGE

It is a matter of great pleasure to know that Astha Foundation, Meerut in collaboration with SKNAU, Jobner, Rajasthan; CSAUAT, Kanpur, U.P.; UAS, Raichur, Karnataka; KSNUAHS, Shivamogga, Karnataka; HPU, Shimla, H.P.; AFU, Rampur Chitwan, Nepal; ICAR-CIFE, Mumbai, Maharashtra and Society for Scientific Development in Agriculture and Technology, Meerut (U.P.) are organizing a three days International Conference on “Global Research Initiatives for Sustainable Agriculture & Allied Sciences (GRISAAS-2024)” during 10–12 December, 2024 at Rajasthan Agriculture Research Institute, Durgapura, Jaipur, Rajasthan.

We are the country with more than 50 percent of our population still dependent on agriculture. It is a challenging fact that even after one decade of twenty-first century. There are ample evidences available that relatively low productivity in our agriculture is due to suboptimal performance related to management aspects rather than low potential. Therefore, the developing countries like us, having optimal potential in the field of technology and services will take strong steps towards second green revolution. I am extremely confident that the discussion among professionals, exchange of ideas, issue and findings during the event will certainly make a far reaching impact on our agriculture system.

I am sure that this event will open new facets and dimensions to bring solutions of the alarming issues before scientific community working towards food security of India.

I express my warm greetings on the occasion and extend my best wishes to the

Dr. Jeet Singh Sandhu

UNIVERSITY OF AGRICULTURAL SCIENCES, RAICHUR

[ICAR, NAAC accredited and UGC u/s 12(B) & 2(f) approved]

Dr. M. HANUMANTHAPPA

M.Sc.(Agri.), Ph.D., PGDAEM

Vice-Chancellor



Website:



Message

Agriculture has changed dramatically and food as well as fiber productivity soared due to new technologies, mechanization, increased chemical use, specialization and government policies that favored maximizing production. These changes allowed fewer farmers with reduced labor demands to produce the majority of the food and fiber in India. In recent years, major adverse impacts of climate change on agriculture are owing to increase in temperature, change in rainfall pattern, weather hazards, decline in soil and water quality, shifting dynamics of insects, diseases, soil flora and fauna, intrusion of sea water on land and biotic and abiotic stresses arising due to climatic extremes. There could be a few positive impacts of climate change on agriculture in some locations because of change in temperature and moisture regimes.

Greenhouse gas emissions that result from the extraction and burning of fossil fuels are major contributors to both climate change and air pollution. Many policies and individual measures, such as transport, food and energy use choices, have the potential to reduce greenhouse gas emissions and produce major health co-benefits, particularly by abating air pollution.

To address the long-term negative impacts of climate change and short and medium term impacts of climatic variability on agriculture, there is a need for sustained research on increased adaptation and mitigation, capacity building, development activities, and bringing necessary changes in policies. These actions have to be accompanied by long-term sustained actions towards generation and strengthening of strategic knowledge system in key impact sectors like water, agriculture, energy, health, etc. by building human and institutional capacity which all these are possible through sustainable agriculture.

I wish all the delegates a wonderful time, comfortable stay and innovative scientific sessions generating useful and practicable inputs for sustainable agriculture through this platform of three days international conference scheduled between 10th–12th December, 2024. I am sure deliberations of the international conference on Sustainable Agriculture will have far reaching effect for developing the futuristic strategy for the benefit of farming community on Sustainable Agriculture.

I wish for commendable success of the conference

A handwritten signature in dark ink, appearing to be 'M. Hanumanthappa'.

[M. Hanumanthappa]

Vice chancellor



ಕೆಲದಿ ಶಿವಪ್ಪ ನಾಯಕ ಕೃಷಿ ವಿಶ್ವವಿದ್ಯಾಲಯ ಮತ್ತು ತೋಟಗಾರಿಕಾ ವಿಜ್ಞಾನ, ಶಿವಮೊಗ್ಗ
**KELADI SHIVAPPA NAYAKA UNIVERSITY OF AGRICULTURAL AND
HORTICULTURAL SCIENCES, SHIVAMOGGA**

Dr. R. C. Jagadeesha
M.Sc. (Agri.), Ph.D.
Vice Chancellor

Iruvakkki- 577 412, Sagara Taluk
Shivamogga, District Karnataka, India

Message

It is a matter of great pleasure to know that **Astha Foundation, Meerut U.P.** and SKNAU, Jobner, Rajasthan; CSAUAT, Kanpur, U.P.; UAS, Raichur, Karnataka; SKRAU, Bikaner, Rajasthan; AU, Jodhpur, Rajasthan; KSNUAHS, Shivamogga, Karnataka; HPU, Shimla, H.P.; ICAR-CIFE, Mumbai, Maharashtra; JNU, Jaipur, Rajasthan; AFU, Rampur, Chitwan, Nepal and Society for Scientific Development in Agriculture and Technology, Meerut, U.P. are jointly organizing a three days IXth International Conference in Hybrid Mode on "Global Research Initiatives for Sustainable Agriculture and Allied Sciences (**GRISAAS-2024**)" from 10 to 12 December, 2024 in hybrid mode at University of Agricultural Sciences, Karnataka, India.

Agriculture in India is very well known since the Indus Valley Civilization. It ranks second in farm outputs worldwide and first in the world with highest net cropped area. In 2016, agriculture and allied sectors like animal husbandry, forestry and fisheries accounted 17.5% of the Gross Domestic Product (GDP) with about 41.49% of the work force in 2020. The agriculture employed > 50% of the Indian work force and contributed 17–18% to the country's GDP as per 2018. The economic contribution of agriculture of India's GDP is steadily declining with the country's broad based economic growth. In spite of this, agriculture is demographically the broadest sector and plays a significant role in the overall socio-economic fabric of India.

Agriculture is no longer an activity for sustenance only it has to be considered as a commercial enterprise in which profitability and sustainability are both equally vital. Farming has to be technology driven with a clear cut focus on reducing cost of cultivation and enhancing productivity and quality of produce. It has to be knowledge based. Without application of science and technology in agriculture and allied fields, the sustainability would remain uncertain considering the challenges being faced by the Agriculture sector worsen by the climate change impacts. It requires a multi-pronged approach to manage natural resources sustainably, enhanced productivity link the production system to storage, processing & value addition and marketing in order to make the entire system, vibrant and employment oriented. I feel that in this conference, the learned delegates will deliberate on burring issues and challenges facing the farming community with emphasis on small and marginal farmers and come out with tangible suggestions. I hope that the outcome of the Conference will help in developing strategies and an action oriented road map to promote sustainable and profitable agriculture.

I congratulate the organizers for their hard work and judicious planning in making this kind of academic interface possible, and wish the conference a grand success.

(R.C. Jagadeesha)

नीलाम्बर-पीताम्बर विश्वविद्यालय



Nilamber-Pitamber University

प्रो. (डॉ.) राम लखन सिंह
पूर्व कुलपति

Prof. (Dr.) Ram Lakhan Singh
Former Vice-Chancellor



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Date:

MESSAGE

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Agriculture is the most important sector of Indian Economy which employs more than half of the population in country. It is also known as the backbone of economy contributing about 16% of total GDP and 10% of total exports in India's economy. There are ample evidences available that relatively low productivity in our agriculture is due to suboptimal performance related to management aspects rather than low potential. Therefore, the developing countries like us, having optimal potential in the field technology and services will have to take strong step towards second green revolution. I am findings during the event will certainly make a far-reaching impact on our agriculture system.

I am sure that this event will open new facets and dimensions to bring solutions of the alarming issue before scientific community working to wards food security of India.

I express my warm greeting on the occasion and extend my best wishes to the organizers.



भारतीय कृषि अनुसंधान परिषद
भा.कृ.अनु.प.-केन्द्रीय मात्स्यिकी शिक्षा संस्थान, मुंबई
(वि.अ.आ. अधिनियम धारा-३ के अंतर्गत विश्वविद्यालय)
ICAR - CENTRAL INSTITUTE OF FISHERIES EDUCATION
(University under Sec.3 of UGC Act)



कृषि एवं किसान कल्याण मंत्रालय, भारत सरकार, Ministry of Agriculture and Farmers Welfare, Govt. of India

डा. रविशंकर सी.एन.

निदेशक / कुलपति

Dr. Ravishankar C.N.

Director / Vice Chancellor



MESSAGE

Innovations can only have the answers to plateauing yield stagnation in crop productivity levels, with challenges in several fronts as reduced land availability and increased demand for food production, crop production is being intensified through higher fertilizer inputs and cropping. The increase in production has to be achieved under conditions of declining and deteriorating land, soil and water resources and at the same time preserving the environmental quality. It will be indeed difficult to meet these daunting challenges only with the application of conventional techniques and tools, as no headway is being made through these approaches. To address the emerging challenges opportunities have to be identified to meet crop production and productivity targets so that the novel variability can be created and harnessed across the species and kingdoms. It is in this context, the of three days VIIIth International Conference in hybrid mode on “**Global Research Initiatives for Sustainable Agriculture & Allied Sciences (GRISAAS-2024)**” organized by **Astha Foundation, Meerut** in collaboration with SKNAU, Jobner, Rajasthan; CSAUAT, Kanpur, U.P.; UAS, Raichur, Karnataka; SKRAU, Bikaner, Rajasthan; AU, Jodhpur, Rajasthan; KSNUAHS, Shivamogga, Karnataka; HPU, Shimla, H.P.; ICAR-CIFE, Mumbai, Maharashtra; JNU, Jaipur, Rajasthan; AFU, Rampur, Chitwan, Nepal and Society for Scientific Development in Agriculture and Technology, Meerut (UP) India, during 10–12 December, 2024 at UAS, Raichur, Karnataka, India.

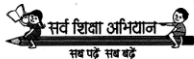
The conference will provide a common platform for all the stake holders to share their Innovation/experiences and expertise to better understand the challenges posed by emerging problems in agriculture and to fine tune future strategies/approaches for addressing such stresses in different areas of agriculture and allied science. I convey my greetings and best wishes to organizers and delegates for their joint venture for the success fo these three days International Conference in hybrid mode.


Ravishankar C. N.

डा. रविशंकर सी.एन./ Dr. Ravishankar C.N.
निदेशक / कुलपति / Director / Vice Chancellor
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ICAR-Central Institute of Fisheries Education
यारी रोड, वरसोवा, मुंबई / Versova, Mumbai-400 061.

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Dr. Binay Kumar Chakraborty

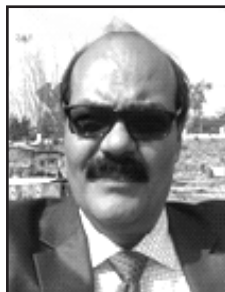
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MESSAGE

I am extremely delighted and privileged that Astha Foundation, Meerut (U.P.) India in association with University of Agricultural Sciences, Raichur, Karnataka, India has been going to organize the 8th International Conference on “Global Research Initiatives for Sustainable Agriculture & Allied Science (GRISAAS-2024)” from 10-12 December, 2024.

The United Nations' declare seventeen Sustainable Development Goals (SDGs) to achieve decent lives for all on a healthy planet by 2030. The Aquatic resource (Aquaculture & Fisheries) has been supporting directly goal no 1. No poverty, 2. Zero hunger, 3. Good health and wellbeing, 5. Gender equality, 6. Clean water and Sanitation, 8. Decent work and economic growth, 13. Climate action and 14. Life below water. On the other hand, according to FAO 2010, the projected population of the world will be 09 billion by 2050. It should not be easy to meet the demand for food, fodder, fuel, fiber, fishery and livestock. Severe challenges of hunger, malnutrition, poor health and loss of biodiversity have to face in the coming future. These challenges are the bottle marks in the process of human development as well. The themes of the conference are very important to mitigate the dietary demand of protein and minerals for human population.

This conference will provide a platform for the research of relevant fields to contemplate and present their research papers along with the opportunity to interact with fellow researchers and academicians of their area of research. I am sure that the delegates and speakers will get a forum to exchange their ideas and come to a concrete conclusion for future Fisheries and Aquaculture developmental planning and conservation of aquatic natural resources.

I congratulate Dr. S.P. Singh, Organizing Chairman, Astha Foundation, Meerut (U.P.) India and entire team for taking up this challenging but momentous initiative. I am, therefore, confident that the three days conference would witness intense academic discourse and discussions which in turn would throw up tentative solutions to the issues in consideration.

With the warm welcome of distinguished scientists and delegates, I wish the conference a grand success in its objective and mission.

(DR. B.K. CHAKRABORTY)

डॉ रणधीर सिंह

पूर्व सहायक महानिदेशक कृषि परिसर

Dr. Randhir Singh

Former Asstt. Director General (Agricultural Extension)



भारतीय कृषि अनुसंधान परिषद

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MESSAGE

Investing in agriculture is one of the most effective ways of promoting agricultural productivity, reducing poverty and enhancing environmental sustainability. Making the transition to sustainable agriculture will not be possible without significant investment to protect and enhance the efficiency of natural resource use and to reduce waste at all stages of production, processing, marketing and consumption. However, rather than just advocating more government and donor funding, this conference calls for new strategies that puts agricultural producers at its centre and focuses public resources at all levels on the provision of public goods and the creation of an enabling environment for investment by farmers. We need to motivate farmers to make investments and also achieve public investments to make this world well fed and hunger free through appropriate resource management.

I hope that this conference, GRISAAS-2024 will be successful in stimulating the global community to put agricultural producers at the centre of investment strategies for agriculture and allied sectors.

Warm wishes for new year and good luck

(Randhir Singh)



Agriculture and Forestry University
Faculty of Animal Science, Veterinary Science and Fisheries
Department of Aquaculture
Rampur, Chitwan, Nepal

Dr. Dilip Kumar Jha
Faculty Chairman



Dated : 04-12-2024

MESSAGE

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I am sure that this event will open new facets and dimensions to bring solutions of the alarming issues before scientific community working towards food security.

I express my warm greetings on the occasion and extend my best wishes to the organizers.

Dilip Kumar Jha, PhD.
Professor and Head
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MESSAGE

Our earth provide the basis for food production. The interaction of different enterprises with different cultures in different climates results in the need for unique approaches to sustainable agricultural systems in each situation. The transition to systems that are both sustainable and sufficiently intense to support the increasing density of human population will be faster or slower depending on the resources available. The renewed recognition of the sustainable resource management for assuring food security and the fundamental role in climate change adaptation and mitigation has triggered numerous projects, initiatives and actions on a global scale. But fertile soils are limited and are increasingly under pressure by competing land uses for cropping, forestry, and pasture/rangeland but also for energy production, settlement and infrastructure, raw materials extraction, etc. Sustaining and feeding the growing population of the world and meeting their needs for biomass (energy), fibre, fodder and other products will be the guiding principles and drivers of future research thrusts on a global scale.

Agriculture in India is highly diversified and crops are grown in diversified environments viz., water logged to rainfed uplands, jhums to deep water, high humid to arid temperatures and flood prone to dry lands. Frequent occurrence of abiotic stresses such as drought and submergence has been identified as the key to the low productivity of rainfed ecosystems. Value addition is the key coupled with rapid technological interventions will upscale the productivity of the small and marginal farmer's of India. It is not recent, significant changes are already happening even in the parched, hungry, degraded lands. The **Astha Foundation, Meerut, UP**, has played significant role in providing suitable forum for exchange of ideas, encouraging research and disseminating knowledge of sustainable agriculture and allied sciences to researchers.

Climate regulation as well as biodiversity conservation and other cultural services, increasing land use changes are threatening this resource and urgent action is needed to reverse this trend if we want to assure the necessary food production for future generations.

Ixth International Conference in Hybrid Mode on “**Global Research Initiatives for Sustainable Agriculture and Allied Sciences**” (GRISAAS-2024) during 10-12 December 2024. The thematic areas chosen for the conference will be very useful for the researchers, development agencies and farmers of the country to understand the practical problems in the agricultural development of our country. Scientists have been at the forefront of our agricultural development in past. They are required to play still more critical role in ensuring sustainable agriculture development. I am sure that conference will address various aspects related to increasing productivity and food & nutritional security. Technologies have helped wipe out malnutrition and hunger and reinvigorating the innovations will spearhead path. I am sure that the outcome of this conference would be very meaningful and will be of immense use for scientists, extension workers and farmers.

S.P. SINGH

Organizing Chairman
GRISAAS-2023

ABOUT GRISAAS

Global research initiatives for sustainable agriculture and allied sciences (GRISAAS), a brain child of **Astha Foundation** to bring scientists, researchers, academicians and all stake holders from throughout the globe for the betterment of humanity with the involvement of all the branches of sciences and related field. The five different themes of sessions were planned for the GRISAAS and these themes itself explains the vision of GRISAAS. These themes of sessions are :

1. Innovation in Crop Improvement, Biotechnology, Genetic Engineering, Precision Horticulture, Agroforestry and Impact of Climate Change on Biodiversity and Food Security.
2. Advances in Disease and Pest Management, Livelihood and Sustainable Management Practices, Post-Harvest Technology, Food Processing and Value Addition for Augmenting Farmer's Income.
3. Key Factor for Crop Productivity : Cropping System, Agronomic and Soil Health Management Practices, Farm Mechanization, Indigenous Technical Knowledge and IPR Issues.
4. Recent Advances in Animal Health, Animal Nutrition & Husbandry, Dairy, Poultry and Fisheries Technology.
5. New Frontiers in Physical, Chemical, Mathematical, Biological, Social Sciences, Remote Sensing, Smart Agriculture, Information Technology, Digital Library and Humanities.

The **first GRISAAS** conference was organized in collaboration with Rajmata Vijayaraje Scindia Krishi Viswa Vidhyalay, Gwalior (M.P.); Society for Scientific Development in Agriculture and Technology (SSDAT), Meerut (U.P.); Scientific Educational Research Society (SERS), Meerut (U.P.) and ALAKH-A Social and Public Welfare Organization, Gwalior (M.P.). It held during 12-13th December, 2015 at Rajmata Vijayaraje Scindia Krishi Viswavidhyalay, Gwalior (M.P.). During the conference, 36 lead papers were presented along with 529 oral and poster presentation in eleven different themes. It received overwhelming response with the registration of more than 1000 participants. All the lead cum invited papers and abstracts of oral and poster presentations were compiled in souvenir and conference book and published with ISBN number. The lead papers in the conference covered almost all the important areas of agriculture and related fields starting from global research initiatives for sustainable agriculture, plant molecular farming status, opportunities and challenges, association mapping in plants, forages as an alternative for diversification of agriculture to backyard poultry farming, strategies for enhancing organic farming profitability, molecular detection of animal diseases, yield gap analysis, newer approaches for weed management and livestock based integrated farming system. many new emerging topics were also delivered during the conference like nano-fertilizers, bio pest management, genome mapping, heavy metal tolerance and clearance, advancement in food processing technologies etc. Overall it was a great fusion of traditional to latest knowledge for the betterment of society.

The **second GRISAAS** International Conference was organized during 02-04th December, 2017 in collaboration of Maharana Pratap University of Agriculture & Technology, Udaipur (Rajasthan); Society for Scientific Development in Agriculture and Technology (SSDAT), Meerut (U.P.); Chandra Shekhar Azad University of Agriculture & Technology, Kanpur (U.P.) and University of Agricultural Sciences, Raichur (Karnataka) at Rajasthan College of Agriculture, Udaipur (Rajasthan). This conference was bestowed with 20 lead papers and 1256 oral and poster presentations in eleven themes with more than 1200 registrations in the conference. All the lead cum invited papers and abstracts of oral and poster presentations were compiled in souvenir and conference book and published with ISBN number. This conference was poured with the knowledge and experience of scientific stalwarts and focused on the doubling the farmers income: a vision of new government of India. It had invited paper on “doubling farmers income through innovative agricultural and allied technology” and related topics like financial inclusion for developing nations, intellectual property rights on biodiversity conservation, advances in post harvest technologies and their applications, various strategies for the disease control in animals and vaccine developments with new generation diagnostics. Many of the crops like rapeseed, cowpea, maize and millets were on the focus of experts and duly addressed. The issues of breeding management for quality seed production, market security in contract farming, nutritional management of soil for optimum output of crops and better management of natural resources e also discussed by the experts during their deliberations and accordingly recommendations were prepared and submitted to respective agencies.

The **third GRISAAS** International Conference was organized during 28-30th October, 2018 in collaboration of S.K.N. Agriculture University, Jobner (Rajasthan); Society for Scientific Development in Agriculture and Technology (SSDAT),

Meerut (U.P.); Chandra Shekhar Azad University of Agriculture & Technology, Kanpur (U.P.); Bihar Agricultural University, Sabour, Bhagalpur (Bihar); Indira Gandhi Krishi Vishwavidhyalay, Raipur (Chattisgarh) and Mahatma Phule Krishi Vidhyapeeth, Rahuri-Pune (Maharashtra) at Rajasthan Agricultural Research Institute, Durgapura, Jaipur (Rajasthan). This international conference involved the presentation of 24 lead papers in 11 different themes of the conference and 820 oral and poster presentations during the conference with more than 1000 participants. All the lead cum invited papers and abstracts of oral and poster presentations were compiled in souvenir and conference book and published with ISBN number. The eminent scientists from different field of sciences presented their researches and findings in respective sessions. The key topics covered during deliberations were global research initiatives for sustainable agriculture, doubling farmer incomes of tribal farmers, improving farmers socio-economic status, agro-forestry a source and media for income, sustainable integrated management approaches for better various plant and animal disease prevention and control through cost effective doorstep farmer friendly diagnostic assays, easy and effective treatment and effective long lasting vaccination programme. A topic of integrated disease management was very well presented with status of safe and effective mastitis vaccine to avoid loss of million dollars to animal and dairy owners annually. Some emerging topics like biosorption through fungi, crop waste management, role of biotechnology in combating abiotic stress and application of micro minerals in crop were also delivered and discussed. Agriculture IPRs related queries were also addressed in respective session and this session also outlined the need of more effective and conducive programme to educate scientific community. Focus was also brought on Plant breeding as it may act as key of success for doubling the farmers income with integrated farming and better coordination of allied departments.

The **fourth GRISAAS** International Conference was organized during 20-22nd October, 2019 in collaboration with Society for Scientific Development in Agriculture and Technology (SSDAT), Meerut (U.P.); Chandra Shekhar Azad University of Agriculture & Technology, Kanpur (U.P.); Bihar Agricultural University, Sabour, Bhagalpur (Bihar); Indira Gandhi Krishi Vishwavidhyalay, Raipur (Chattisgarh); University of Agriculture and Horticulture, Shivamoga (Karnataka) and Mahatma Phule Krishi Vidhyapeeth, Rahuri- Pune (Maharashtra) at ICAR-National Academy of Agricultural Research Management (NAARM), Rajendranagar, Hyderabad (Telangana). This international conference involved the presentation of 26 lead papers in 11 different themes of the conference and 561 oral and poster presentations during the conference with more than 800 participants. All the lead cum invited papers and abstracts of oral and poster presentations were compiled in souvenir and conference book and published with ISBN number. Now the time has changed significantly likewise application of artificial intelligence based technology like drones, microRNA based diagnosis and nanoparticles based fertilizers, mineral mixtures and vaccines in agriculture and allied subjects with the target to improve the socioeconomic status of farming community. Various expert lectures from diversified fields from all over the India and abroad present lead cum invited papers focusing the respective themes and accordingly discussions were focused on the lab to field transfer of technology in farmer friendly mode so that these can easily demonstrated to farmers and they can also easily adopt the changes to get benefitted from the technologies developed by the scientific community. The integrated system of farming involving dairy, poultry, goatry, piggery and fishery appeared to be game changers and many of the farmers based farming system like mushroom production, beekeeping along with routine farming practices were recommended to increase their income in the system. The team efforts of scientific and farming community appeared to be baseline for next revolution with the adaptation of new technologies in agriculture and allied field. The detailed discussion on contract farming and its pros and cons suggested careful adaptation and through examination of contract conditions as majority of farmers are still not technically competent to know the aftereffects of contract. The government agencies should provide legal assistance to farming community to avoid any adverse consequences.

The **fifth GRISAAS** International Conference is being organized during 28-30th December, 2020 from the headquarter of Astha foundation, Meerut (U.P.). Considering the post pandemic effect and travel restrictions, it is being organized in collaboration with Society for Scientific Development in Agriculture and Technology (SSDAT), Meerut (U.P.); Chandra Shekhar Azad University of Agriculture & Technology, Kanpur (U.P.); Bihar Agricultural University, Sabour, Bhagalpur (Bihar); Indira Gandhi Krishi Vishwavidhyalay, Raipur (Chattisgarh); University of Agriculture and Horticulture, Shivamoga (Karnataka), Bihar Agricultural University, Ranchi, Jharkhand and Swami Keshwanand Rajasthan Agricultural University, Bikaner, Rajasthan on online mode. In spite of corona pandemic it has received overwhelming response with more than 1000 registrations and presentation of more than 500 oral and posters during three days conference, As usual 11 themes will have

lead cum invited papers of experts of national and International repute in respective themes during the conference. All the lead cum invited papers and abstracts of oral and poster presentations have been compiled in souvenir and conference book and being published with ISBN number. This time it will be also available on online mode at society website www.asthafoundation.in. This conference is going to address the current scenario on farmers bills and doubts of farming community on these bills. Many of the experts including some foreign experts are expected to deliver invited papers in different themes of conference. The presence of stalwarts from the different part of country is going to have excellent deliberations and outcomes to be recommended to responsible agencies for the betterment of farmers and dairy sectors.

The **sixth GRISAAS** International Conference was scheduled in hybrid mode during 13-15th December, 2021 from the Swami Keshwanand Rajasthan Agricultural University, Bikaner, Rajasthan. However, due to COVID new guidelines and restrictions due to OMICRON variant of corona, university showed its inability to host it in physical mode so it is being organized from the headquarter of Astha foundation, Meerut (U.P.). The collaboration of Society for Scientific Development in Agriculture and Technology (SSDAT), Meerut (U.P.); Chandra Shekhar Azad University of Agriculture & Technology, Kanpur (U.P.); Bihar Agricultural University, Sabour, Bhagalpur (Bihar); Indira Gandhi Krishi Vishwavidhyalay, Raipur (Chhattisgarh); University of Agriculture and Horticulture, Shivamoga (Karnataka) and Bihar Agricultural University, Ranchi, Jharkhand is continued for online mode. GRISAAS-2021 has the highest number of registration in the conference with the registration of 1217 participants. It showed the linkage and faith of scientific community in the Astha Foundation and SSDAT. As usual, 11 themes are in the schedule. All the lead cum invited papers and abstracts of oral and poster presentations were compiled in souvenir and conference book and published with ISBN number. It is also available on online mode at society website www.asthafoundation.in. This conference addressed the current scenario on farmers bills and doubts of farming community on these bills. Many of the experts including some foreign experts from Nepal, Bangladesh and Sri Lanka delivered key note address. The presence of stalwarts, scientists, students and extension workers in the conference and sharing their work, thoughts and visions was of use for students, emerging scientists and for farming community. The recommendation of the three days seminar have been submitted to all the major stake holders for desired applications in policy and farmer friendly setups to double the farmer's income.

The **seventh GRISAAS** International Conference was scheduled in hybrid mode during 21-23rd November, 2022 at the Birsa Agricultural University, Ranchi Jharkhand in collaboration of Astha foundation, Meerut (U.P.). This international conference has the partner organization like the Society for Scientific Development in Agriculture and Technology (SSDAT), Meerut (U.P.); Chandra Shekhar Azad University of Agriculture & Technology, Kanpur (U.P.); Bihar Agricultural University, Ranchi, Jharkhand, Rani Laxmi Bai Centenary Agriculture University, Jhansi; Sri Keshwanand Rajasthan Agricultural University, Bikaner, Rajasthan; ICAR-CIFE, Mumbai, Maharashtra; Agriculture and Forestry University, Chitwan, Nepal; NPU, Palamu, Jharkhand and RK (PG) College, Shamli, Uttar Pradesh. Like the previous events, GRISAAS-2022 also has the overwhelming response with more than 1000 participants in both off and on line mode. It has again proven the linkage and faith of scientific community in the Astha Foundation and SSDAT. Like sixth GRISAAS 11 themes are in the schedule. All the lead cum invited papers and abstracts of oral and poster presentations have been compiled in souvenir and conference book and will be shortly published with ISBN number. It will also be available on online mode at society website www.asthafoundation.in. This conference is going to address the current scenario on farmers, agriculture, animal health care and effect of climate change on both animal and agriculture practices. Many of the experts including some foreign experts from Nepal and Bangladesh will deliver key note address. The presence of stalwarts, scientists, students and extension workers in the conference and sharing their work, thoughts and visions will be useful for students, emerging scientists and for farming community. The recommendation of the three days seminar have been submitted to all the major stake holders for desired applications in policy and farmer friendly setups to double the farmer's income.

The **earth GRISAAS** International Conference was scheduled in hybrid mode during 18-20th December, 2023 at the University of Agricultural Sciences, Raichur, Karnataka in collaboration of Astha foundation, Meerut (U.P.). This international conference has the partner organization like the Society for Scientific Development in Agriculture and Technology (SSDAT), Meerut (U.P.); Chandra Shekhar Azad University of Agriculture & Technology, Kanpur (U.P.); Bihar Agricultural University, Ranchi, Jharkhand; KSNUAHS, Shivamogga, Karnataka; HPU, Shimla, H.P.; ICAR-CIFE, Mumbai, Maharashtra; Agriculture and Forestry University, Chitwan, Nepal and RK (PG) College, Shamli, Uttar Pradesh. Like the

previous events, GRISAAS-2023 also has the overwhelming response with more than 600 participants in both off and on line mode. It has again proven the linkage and faith of scientific community in the Astha Foundation and SSDAT. All the lead cum invited papers and abstracts of oral and poster presentations have been compiled in souvenir and conference book and will be shortly published with ISBN number. It will also be available on online mode at Astha Foundation website www.asthafoundation.in. This conference is going to address the current scenario on farmers, agriculture, animal health care and effect of climate change on both animal and agriculture practices. Many of the experts including some foreign experts from USA, Phillipines, Nepal and Bangladesh will deliver key note address and oral presentation. The presence of stalwarts, scientists, students and extension workers in the conference and sharing their work, thoughts and visions will be useful for students, emerging scientists and for farming community.

The **ninth GRISAAS** International Conference is scheduled in hybrid mode during 10-12th December, 2024 at SKNAU-RARI, Durgapura, Jaipur, Rajasthan in collaboration of Astha foundation, Meerut (U.P.). This international conference has the partner organization like the Society for Scientific Development in Agriculture and Technology (SSDAT), Meerut (U.P.); Chandra Shekhar Azad University of Agriculture & Technology, Kanpur (U.P.); University of Agricultural Sciences, Raichur, Karnataka; Bihar Agricultural University, Ranchi, Jharkhand; KSNUAHS, Shivamogga, Karnataka; HPU, Shimla, H.P.; ICAR-CIFE, Mumbai, Maharastra; SKRAU, Bikaner, Rajasthan, AU, Jodhpur, Rajasthan, JNU, Jaipur, Rajasthan and Agriculture and Forestry University, Chitwan, Nepal. Like the previous events, GRISAAS-2024 also has the overwhelming response with more than 500 registration in the conference till date and more likely to registered 12 December in both off and on line mode. It has again proven the linkage and faith of scientific community in the Astha Foundation and SSDAT. Like seventh GRISAAS, 5 themes are in the schedule. All the lead cum invited papers and abstracts of oral and poster presentations have been compiled in souvenir and conference book and will be shortly published with ISBN number. It will also be available on online mode at Astha Foundation website www.asthafoundation.in. This conference is going to address the current scenario on farmers, agriculture, animal health care and effect of climate change on both animal and agriculture practices. Many of the experts including some foreign experts from USA, Phillipines, Nepal and Bangladesh will deliver key note address and oral presentation. The presence of stalwarts, scientists, students and extension workers in the conference and sharing their work, thoughts and visions will be useful for students, emerging scientists and for farming community. The recommendation of the three days conference have been submitted to all the major stake holders for their attention and perusal on the current issues affecting Indian rural economy.



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Lead Papers/ Invited Papers



GLOBAL RESEARCH INITIATIVES FOR SUSTAINABLE AGRICULTURE (GRISAAS)

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Worldwide demands for food increases (population of over 8 billion by 2025) while land and water become increasingly scarce and human health issues rise and threaten food systems and their sustainability. There will be no sustainable future without eradicating poverty and hunger. Ensuring food security for all is both a key function of and a challenge for agriculture, which faces ever-increasing difficulties – as populations rise, urbanization increases and incomes grow; the agricultural sector will be under mounting pressure to meet the demand for safe and nutritious food. Agriculture has to generate decent jobs and support the livelihoods of billions of rural people across the globe, especially in developing countries where hunger and poverty are concentrated. Furthermore, the sector has a major role to play in ensuring the sustainability of the world's precious natural resources and biodiversity, particularly in light of a changing climate. Climate change will have an increasingly adverse impact on many regions of the world, with those in low latitudes being hit the hardest. Developing countries, in particular, will need support from the global community to facilitate their adaptation and mitigation efforts in relation to climate change and to transform their agriculture and food systems sustainably. As the migration crisis of recent years has shown, no country stands unaffected. What happens in one part of the globe will undoubtedly affect other parts, and domestic and foreign policies must take account of this.

Global Agriculture Research institutes

At global level only mandated international agricultural research organization is the CGIAR. The CGIAR Fund supports 15 international agricultural research centers such as the International Water Management Institute (IWMI), International Rice Research Institute (IRRI), the International Institute of Tropical Agriculture (IITA), the International Livestock Research Institute (ILRI), the International Food Policy Research Institute (IFPRI) and the Center for International Forestry Research (CIFOR) that form the CGIAR Consortium of International Agricultural Research Centers and are located in various countries worldwide (as of 2011). The centers carry out research on various Agricultural commodities, livestock, fish, water, forestry, policy and management. Some other international agricultural organizations include the United Nations Food and Agriculture Organization, Global Forum on Agricultural Research (GFAR), The International Agriculture Center (Netherlands), The World Bank, International Fund for Agricultural Development, The Center for International Food and Agriculture Policy at the University of Minnesota. The CGIAR (Consultative Group on International Agricultural Research) is a small but significant component of the global agricultural research system. With its limited financial resources, it has to be selective in its role and choice of research portfolio. An updated report on CGIAR priorities and strategies is produced every five years by TAC (Technical Advisory Committee to the CGIAR) to guide system-wide resource allocation taking into consideration an appropriate balance between centers, activities, commodities, regions and agro-ecological zones. In considering priorities, TAC is guided by several important factors such as the CGIAR mission and goal, emerging trends in world agriculture, and the evolution of scientific capacity in developing countries. The current approach has been modified to account for the expanded mandate of the CGIAR, greater emphasis on sustainability and resource management issues, allow for meaningful interactions with stakeholders, ensure transparency in decision making, and develop mechanisms which facilitate CGIAR priority setting as a continuing activity.

Research priorities decided by CGIAR

According to Nelson and Mensbrugghe (2013) CGIAR decided public sector agricultural research priorities for sustainable



food security and agricultural strategies to support food security in climate change. The focus is on the vulnerable small holder agricultural households that do not consistently and fully meet household nutritional needs. Climate change poses great risks to this group because it is dependent on agricultural production to meet both income and nutritional needs. Climate change also poses additional challenges to meet the individual and collective ambitions of development. The responses to climate change are varied, ranging from increasing resilience by development and adoption of new cultivars, maintaining eco-systems services such as soil health and water quality, diversification, and improved risk management tools. Climate change increases the value of “no-regrets” technologies that enhance flexibility and potentially enable transformative changes. Some technologies exist that can help with adaptation; others need to be developed. But while technology availability is a first step condition, adoption by farmers is the essential outcome. Adoption requires greater emphasis on building local institutions to support information dissemination, risk management and collective action. Two other important enabling conditions are building coherence across agriculture, food security and climate change policies and increasing the available financing, including from climate finance sources. Priorities include: Better links with the global climate change research community are needed to address the nature of the vulnerability and uncertainties. This has to include better understanding of the likely changes in climate variability in the coming decades and its impacts on food systems and food security at all levels. Therefore, improving tools and guidelines for risk management, including better knowledge of the role of assets (physical, human and social capital), role of collective action and increased engagement of civil society to improve participatory approaches and communication is important in present scenario. There was a lively debate on the relative priorities between technology development and improving systems for technology adoption, and the optimal division between the public and private sectors. How can we better use the new technologies available today for information dissemination? Allocation of water among various users, including agriculture, as well as competition for land use from biofuels merits greater attention. What should be the relative roles of mitigation *versus* adaptation? How much mitigation can be expected from small holder farmers? What are the equity concerns? How can development be made compatible with mitigation? Should we focused on a ‘climate justice’ approach (analogous to the ‘right-to-food’ approach) given the inability of the global community to take effective action to limit greenhouse gas emissions. Attention to gender differences in the way of information is absorbed and transmitted is important for technology adoption and mitigation. More collaboration is needed with a focus on data collection and dissemination and links across the different modeling platforms (across disciplines, e.g. climate to crop to economic, and across dimensions, household/farm to sub-region to country to global).

What is Sustainable Agriculture: Every day, farmers and ranchers around the world develop new, innovative strategies to produce and distribute food, fuel and fiber sustainably. While these strategies vary greatly, they all embrace three broad goals, or what SARE calls the three pillars of sustainability: Profit over the long term, stewardship of nation’s land, air and water and quality of life for farmers, ranchers and their communities. The phrase ‘sustainable agriculture’ was reportedly coined by the Australian agricultural scientist Gordon McClymont. Wes Jackson is credited with the first publication of the expression in 1980 in his book “New Roots for Agriculture”. The term became popular in the late 1980s. It has been defined as “an integrated system of plant and animal production practices having a site-specific application that will last over the long term, for example to satisfy human food and fiber needs, to enhance environmental quality and the natural resource base upon which the agricultural economy depends, to make the most efficient use of non-renewable and on-farm resources and integrate natural biological cycles and controls, to sustain the economic viability of farm operations, and to enhance the quality of life for farmers and society as a whole.

There are several key principles associated with sustainability in agriculture and important thing is the incorporation of biological and ecological processes into agricultural and food production practices. For example, these processes could include nutrient cycling, soil regeneration, and nitrogen fixation.

Using decreased amounts of non-renewable and unsustainable inputs, particularly the ones that are environmentally harmful.

Using the expertise of farmers to both productively work the land as well as to promote the self-reliance and self-sufficiency of farmers.

Solving agricultural and natural resource problems through the cooperation and collaboration of people with different skills. The problems tackled include pest management and irrigation.

Sustainable agriculture can be understood as an ecosystem approach to agriculture. Practices that can cause long-term damage



to soil include excessive tilling of the soil (leading to erosion) and irrigation without adequate drainage (leading to salinization). Long-term experiments have provided some of the best data on how various practices affect soil properties essential to sustainability. In the United States a federal agency, USDA-Natural Resources Conservation Service, specializes in providing technical and financial assistance for those interested in pursuing natural resource conservation and production agriculture as compatible goals.

Initiatives by United Nations for sustainable development

The year 2015 signaled the arrival of two landmark initiatives that recognized the need for countries to take collective action to promote sustainable development and combat climate change: the 2030 Agenda for Sustainable Development and its 17 Sustainable Development Goals (SDGs), and the Paris Agreement of the United Nations Framework Convention on Climate Change (UNFCCC). Both initiatives reflect evolving thinking around global issues, and both call for a fair and transparent international trade system. In food and agriculture, trade can play a role and contribute to meeting the targets of both the 2030 Agenda and the Paris Agreement.

In the meeting at the United Nations Headquarters in New York from 25-27 September 2015 as the Organization celebrated its seventieth anniversary, have decided on new global Sustainable Development Goals. UN adopted a historic decision on a comprehensive, far-reaching and people-centered set of universal and transformative Goals and targets and committed to working tirelessly for the full implementation of this Agenda by 2030.

The sustainable development goals : The sustainable development goals (SDGs) are a new, universal set of goals, targets and indicators that UN member states will be expected to use to frame their agendas and political policies over the next 15 years. The SDGs follow and expand on the millennium development goals (MDGs), which were agreed by governments in 2001 and are due to expire at the end of this year.

Need for set of goals : There is broad agreement that, while the MDGs provided a focal point for governments – a framework around which they could develop policies and overseas aid programmes designed to end poverty and improve the lives of poor people – as well as a rallying points for NGOs to hold them to account, they were too narrow.

The eight MDGs – reduce poverty and hunger; achieve universal education; promote gender equality; reduce child and maternal deaths; combat HIV, malaria and other diseases; ensure environmental sustainability; develop global partnerships – failed to consider the root causes of poverty and overlooked gender inequality as well as the holistic nature of development. The goals made no mention of human rights and did not specifically address economic development. While the MDGs, in theory, applied to all countries, in reality they were considered targets for poor countries to achieve, with finance from wealthy states. Conversely, every country will be expected to work towards achieving the SDGs.

Proposed 17 Sustainable Development Goals (SDGs)?

- End poverty in all its forms everywhere
- End hunger, achieve food security and improved nutrition and promote sustainable agriculture
- Ensure healthy lives and promote well being for all at all ages
- Ensure inclusive and equitable quality education and promote life long learning opportunities for all
- Achieve gender equality and empower all women and girls
- Ensure availability and sustainable management of water and sanitation for all
- Ensure access to affordable, reliable, sustainable and modern energy for all
- Promote sustained, inclusive and sustainable economic growth, full and productive employment, and decent work for all
- Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation
- Reduce inequality within and among countries
- Make cities and human settlements inclusive, safe, resilient and sustainable
- Ensure sustainable consumption and production patterns
- Take urgent action to combat climate change and its impacts (taking note of agreements made by the UNFCCC forum)
- Conserve and sustainably use the oceans, seas and marine resources for sustainable development
- Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
- Strengthen the means of implementation and revitalize the global partnership for sustainable development



The interlinkages and integrated nature of the Sustainable Development Goals are of crucial importance in ensuring that the purpose of the new Agenda is realized. If we realize our ambitions across the full extent of the Agenda, the lives of all will be profoundly improved and our world will be transformed for the better.

The Global Research Alliance (GRA) :It is an international network of nine applied research organizations that works to promote application of science and technology to solve large scale issues facing developing countries. The alliance was formed in 2000 in Pretoria, South Africa. Today, the GRA has access to over 60,000 people across its membership. Vision is for a world where the application of innovative science and technology, through collaboration and co-creation, delivers access equality, improves lives, and solves global development challenges. The GRA uses the best science and technology to solve some of the biggest problems in the developing world. These global issues span borders, cultures and religions and require a cross-boundary response. They address these problems by :

Mobilizing the creative energy of our globally and culturally diverse researchers to address global development challenges through innovation

Sharing the breadth and depth of our science and technology resources and uniting with local partners, communities, industry and collaborators

Generating and implementing appropriate, affordable and sustainable solutions with positive and lasting impact

The GRA is a dynamic alliance of nine knowledge intensive research and technology organizations from around the world. Its goal is to create 'A Global Knowledge Pool for Global Good'. The focus is to apply science, technology and innovation in the pursuit of solving some of world's gravest challenges.

GRA and Inclusive Innovation : The Global Research Alliance (GRA) believes Inclusive Innovation requires a holistic and new way of approaching demand-driven projects and co-creation with partners such as end-users, technology organizations and both the private and public sectors. This includes: success through technical innovation (products), social innovation (interaction/co-creation), management innovation (business models); and chain innovation (relationships in the value chain). Inclusive Innovation is not new to the GRA. Over the last few years, the GRA has systematically addressed global challenges through the deployment of Inclusive Innovation initiatives.

Why do we need climate-smart agriculture: The UN Food and Agriculture Organization (FAO) estimates that feeding the world population will require a 60 percent increase in total agricultural production. With many of the resources needed for sustainable food security already stretched, the food security challenges are huge. At the same time climate change is already negatively impacting agricultural production globally and locally. Climate risks to cropping, livestock and fisheries are expected to increase in coming decades, particularly in low-income countries where adaptive capacity is weaker. Impacts on agriculture threaten both food security and agriculture's pivotal role in rural livelihoods and broad-based development. Also the agricultural sector, if emissions from land use change are also included, generates about one-quarter of global greenhouse gas emissions.

Practical adaptation options to improve food security and resilience: What practical steps can smallholder farmers take to adapt their agricultural practices to secure dependable food supplies and livelihoods? And can they do this while also decreasing greenhouse gas emissions or increasing carbon sequestration, thereby decreasing future climate change?

In a search for answers the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) is working with a vast range of partners to test a range of interventions in climate-smart villages. This Flagship addresses the challenge of how to transition to climate-smart agriculture at a large scale. We work with partners at all levels to test, evaluate, promote and scale up integrated portfolios of technologies and practices that meet the needs of farmers - including women and marginalized groups. We help build adaptive capacity and resilience to climate variability and change, while increasing food availability and generating mitigation co-benefits. We integrate, and apply the best and most promising methods, tools and approaches for equitable local adaptation planning and governance, and develop innovative incentives and mechanisms for scaling out CCAFS identifies agricultural development options that reduce greenhouse gas emissions and increase carbon sequestration. Together with our partners, CCAFS produces research to improve estimates of farm emissions in smallholder systems, provides tools and information to agriculture decision-makers and supports the widespread implementation of low emissions agricultural practices and policies.

The Global Water Partnership's : The vision is for a water secure world. It's mission is to support the sustainable development and management of water resources at all levels. GWP was founded in 1996 by the World Bank, the United



Nations Development Programme (UNDP), and the Swedish International Development Cooperation Agency (SIDA) to foster integrated water resource management (IWRM).

IWRM is a process which promotes the coordinated development and management of water, land and related resources in order to maximize economic and social welfare without compromising the sustainability of ecosystems and the environment. The network is open to all organizations involved in water resources management: developed and developing country government institutions, agencies of the United Nations, bi- and multi-lateral development banks, professional associations, research institutions, non-governmental organizations, and the private sector. In the “Our Approach” section one can read about GWP’s global strategy - Towards 2020 - how GWP are currently pursuing vision of water security. Dealing with water issues requires commitment at the highest political level. Water security will only be reached when political leaders take the lead, make the tough decisions about the different uses of water and follow through with financing and implementation. GWP sees its role as having the technical expertise and convening power to bring together diverse stakeholders who can contribute to the social and political change processes that help bring the vision of a water secure world closer to reality. GWP regularly reports on outcomes at the national, regional, and global level. GWP is implementing its strategy and up-to-date information on activities across the globe.

The Global Water Partnership (GWP) has announced the launch of its new 2014-2019 global strategy. The strategy, Towards 2020, outlines a new direction for GWP with the goals of catalyzing change, sharing knowledge, and strengthening partnerships for a water secure world. The 2014-2019 Strategy builds on GWP’s previous work and achievements. It was developed through a year-long process of regional dialogues and consultations with GWP’s growing network of over 2,900 Partner Organizations across 172 countries. The strategy Towards 2020 stresses the need for innovative and multi-sectorial approaches to adequately address the manifold threats and opportunities relating to sustainable water resource management in the context of climate change, rapid urbanization, and growing inequalities.

Global Soil Partnership: Soil is under pressure. The renewed recognition of the central role of soil resources as a basis for food security and their provision of key ecosystem services, including climate change adaptation and mitigation, has triggered numerous regional and international projects, initiatives and actions. Despite these numerous emergent activities, soil resources are still seen as a second-tier priority and no international governance body exists that advocates for and coordinates initiatives to ensure that knowledge and recognition of soils are appropriately represented in global change dialogues and decision making processes. At the same time, there is need for coordination and partnership to create a unified and recognized voice for soils and to avoid fragmentation of efforts and wastage of resources.

Maintaining healthy soils required for feeding the growing population of the world and meeting their needs for biomass (energy), fiber, fodder, and other products can only be ensured through a strong partnership. This is one of the key guiding principles for the establishment of the Global Soil Partnership.

Responses to soils today :

Soil data : fragmented, partly outdated (fertility, SOC, etc.) heterogeneous and difficult to compare, not easily accessible, not responding to users’ needs

Soil capacities : increasingly a scarce resources (loss of soil expertise and skills)

Soil knowledge and research: fragmented (fertility, CC, ecology), domain of soil scientists, not accessible for use by various disciplines and for decision making, not tailored to address problems/development agendas of today

Awareness and investments in soil management : extremely low compared to the needs that soil is a precarious resource and requires special care from its users

Soil policy : Often received as a second tier priority; lack of international governance body to support coordinated global action on their management. Need for compatible and coordinated soil policies - a unified and authoritative voice is needed to better coordinate efforts and pool limited resources (for agriculture, forestry, food security, UNCCD, CBD, UNFCCC, disaster and drought management, land competition, rural and urban land use planning and development).

Intergovernmental Panel on Climate Change (IPCC) is the leading international body for the assessment of climate change. It was established by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) in 1988 to provide the world with a clear scientific view on the current state of knowledge in climate change and its potential environmental and socio-economic impacts. In the same year, the UN General Assembly endorsed the action by WMO and UNEP in jointly establishing the IPCC. The IPCC is a scientific body under the



auspices of the United Nations (UN). It reviews and assesses the most recent scientific, technical and socio-economic information produced worldwide relevant to the understanding of climate change. It does not conduct any research nor does it monitor climate related data or parameters. Thousands of scientists from all over the world contribute to the work of the IPCC on a voluntary basis. Review is an essential part of the IPCC process, to ensure an objective and complete assessment of current information. IPCC aims to reflect a range of views and expertise. The Secretariat coordinates all the IPCC work and liaises with Governments. It is established by WMO and UNEP and located at WMO headquarters in Geneva. Because of its scientific and intergovernmental nature, the IPCC embodies a unique opportunity to provide rigorous and balanced scientific information to decision makers. By endorsing the IPCC reports, governments acknowledge.

The Intergovernmental Technical Panel on Soils (ITPS) was established at the first Plenary Assembly of the Global Soil Partnership held at FAO Headquarters on 11 and 12 of June, 2013. The ITPS is composed of 27 top soil experts representing all the regions of the world. The main function of the ITPS is to provide scientific and technical advice and guidance on global soil issues to the Global Soil Partnership primarily and to specific requests submitted by global or regional institutions. The ITPS will advocate for addressing sustainable soil management in the different sustainable development agendas.

Functions of ITPS :

Provide scientific and technical advice on global soil issues primarily to the GSP and in relation to specific requests submitted by global or regional institutions.

Advocate for the inclusion of sustainable soil management into different development agendas.

Review and follow up on the situation and issues related to soils in the contexts of food security, use and management of natural resources, ecosystem services provision, climate change adaptation and mitigation, and other relevant areas.

Review and endorse from a technical view point the GSP Plans of Action.

Follow up on the implementation of these Plans of Action with due attention to their impact and contributions to different global policies and initiatives related to sustainable development, MDGs, food security, climate change adaptation and other subject matters.

In exceptional cases, when complex technical matters arise, request the Plenary Assembly and the Secretariat to form technical committees aiming to gather specific advice.

Intergovernmental Platform on Biodiversity and Ecosystem Services : The Intergovernmental Platform on Biodiversity and Ecosystem Services is a mechanism proposed to further strengthen the science-policy interface on biodiversity and ecosystem services, and add to the contribution of existing processes that aim at ensuring that decisions are made on the basis of the best available scientific information on conservation and sustainable use of biodiversity and ecosystem services. It was established in 2012 as an independent intergovernmental body open to all member countries of the United Nations. The members are committed to building IPBES as the leading intergovernmental body for assessing the state of the planet's biodiversity, its ecosystems and the essential services they provide to society.

Science-policy interface : Science-policy interfaces are social processes which encompass relations between scientists and other actors in the policy process, and which allow for exchanges, co-evolution, and joint construction of knowledge with the aim of enriching decision-making at different scales. This includes two main requirements: scientific information is relevant to policy demands and is formulated in a way that is accessible to policy and decision makers; and that policy and decision makers take into account available scientific information in their deliberations and that they formulate their demands or questions in a way that are accessible for scientists to provide the relevant information.

Need for IPBES : There are already several mechanisms and processes at national, regional and global level that are designed to ensure that scientific information is considered when designing policies or making decisions (examples of this are technical bodies/panels under the environmental agreements or national research institutions attached to ministries, among many others). However, there is no global ongoing mechanism recognized by the scientific and policy communities, that pulls this information together, synthesizes and analyzes it for decision making in a range of policies. Thus, we have listed some of the numerous global alliances which have been established to address the global research platforms. This is in brief and there are others also across the globe taking shapes : One of the fundamental lessons learned through the past half century of agricultural research is that there are no "one size fits all" sustainable management practices and a holistic approach is the need of the hour.



Sustainable development in Indian Agriculture

Agriculture is the main occupation in India as large population is living in the rural areas and having agriculture as their livelihood. Sustainable development in the agriculture sector aims to increase the productivity, efficiency and level of employment and further aims to protect and preserve the natural resources by the over utilization. Agriculture faces many challenges, making it more and more difficult to achieve its primary objective – feeding the world – each year. Agriculture must change to meet the rising demand, to contribute more effectively to the reduction of poverty and malnutrition, and to become ecologically more sustainable India has been witnessing a blinding pace of growth and development in recent times. Experts are now calling for “sustainable development” and the term has gained currency in the last few years. In spite of fast growth in various sectors, agriculture remains the backbone of the Indian economy. Sustainable agricultural development seeks not only to preserve and maintain natural resources, but also to develop them, as future generations would have much more demand quantity-wise and quality-wise for agricultural and food products. Such goals should ensure a balance with the development of livelihoods enjoyed by the individuals concerned. Agriculture plays a crucial role in sustainable development and in hunger and poverty eradication. The challenges faced by agriculture in sustainable development is in working out ways of bringing about a society that is materially sufficient, socially equitable, and ecologically sustainable and one that is not obsessed by growth only, but motivated by satisfying human needs and equity in resource allocation and use. Sustainable agriculture must meet economic, social and ecological challenges. All 4 these challenges are closely related. Sustainable agriculture needs to protect the natural resource base, prevent the degradation of soil and water; conserve biodiversity; contribute to the economic and social well-being of all; ensure a safe and high-quality supply of agricultural products; and safeguard the livelihood and well-being of agricultural workers and their families. The main tools towards sustainable agriculture are policy and agrarian reform, participation, income diversification, land conservation and improved management of inputs. This policy document is an effort to identify the strategies, guidelines and practices that constitute the Indian concept of sustainable agriculture. This is done in order to clarify the research agenda and priorities thereof, as well as to suggest practical steps that may be appropriate for moving towards sustainable agriculture. Some tend to confuse sustainable agriculture with organic farming. But both are very different from each other. Sustainable agriculture means not only the withdrawal of synthetic chemicals, hybrid-genetically modified seeds and heavy agricultural implements (as in organic farming). Sustainable agriculture involves multiculture, intercropping, use of farmyard manure and remnants, mulching and application of integrated pest management. If this is followed then there is no reason why agriculture cannot be an economically viable activity in addition to being environmentally sustainable.

In India, the crop yield is heavily dependent on rain, which is the main reason for the declining growth rate of agriculture sector. These uncertainties hit the small farmers and laborers worst, which are usually leading a hand to mouth life. Therefore, something must be done to support farmers and sufficient amount of water and electricity must be supplied to them as they feel insecure and continue to die of drought, flood, and fire. India is the second largest country of the world in terms of population; it should realize it is a great resource for the country. India has a huge number of idle people. There is a need to find ways to explore their talent and make the numbers contribute towards the growth. Especially in agriculture, passive unemployment can be noticed. The sustainable development in India can also be achieved by full utilization of human resources. A large part of poor population of the country is engaged in agriculture, unless we increase their living standard, overall growth of this country is not possible. If we keep ignoring the poor, this disparity will keep on increasing between classes. Debt traps in country are forcing farmers to commit suicides. People are migrating towards city with the hope of better livelihood but it is also increasing the slum population in cities. Therefore, rural population must be given employment in their areas and a chance to prosper. India has been carrying the tag of “developing” country for quite long now; for making the move towards “developed” countries, we must shed this huge dependence on agriculture sector.

For promoting sustainable agriculture, following components can be considered :

Yield increase : India need to focus on improving its yields. Currently, yield level of food crops is 2,056 kg/ha, which is far below the yields of many countries. The current average yield of paddy in India is around 3.5 tonnes /ha, while China’s yield is more than 6 tonnes/ha. Similar is the case with wheat and other major crops. This is despite increase in fertilisers and pesticides by several folds.

Water-use efficiency : India is still focusing on supply side management of water. This is leading to major investments while causing degradation of ecosystems without any major benefit to farmers. The investments have to be clearly on reducing the



water per unit of production. Currently, the focus of drip irrigation is only on material supply rather than the entire process and training. Creating specific incentives for using less water while improving the productivity have not even initiated. With modern technology, it is possible to create incentives to use less water and set up mechanisms to monitor water use at farm level. Budget should be allocated for creating well-designed projects with institutional mechanisms to implement and monitor. The goal is to use the existing infrastructure far more efficiently—both at system level and individual farm level.

Diversity of food grains: Consumers are aware of the benefits of eating coarse grains such as jowar and bajra. But there are no specific programmes to produce and market these food grains. Farmers need income, not just production. So, incentivizing farmers to produce these grains will not only save water and ecosystems but promote healthy eating habits.

Farm-based approaches: In India, farmers are receptive to experimenting with farm-based approaches. For example, the System of Rice Intensification (SRI), Sustainable Sugarcane Initiative (SSI), and System of Crop Intensification (SCI) of wheat, millets and mustard are very popular with farmers. It is time we had Centre-sponsored scheme to promote these approaches in large scale with large budget provisions and institutional mechanisms.

Organic agriculture: India needs to slowly move from chemical-based farming to organic farming. Phase-wise approach towards removing subsidies to chemical fertilizers and introducing incentives to organic agriculture through budget provisions is the way to go about it, by conducting the conferences like GRISAAS we will be able to address these issues efficiently.



RESEARCH INITIATIVES FOR SUSTAINABLE AGRICULTURE-INDIAN PERSPECTIVES

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Indian agriculture has made tremendous progress during last 10 years and total food grains production has increased from the 263.50 million tonnes (2013-14) to more than 332.29 m t (2023-24) thereby registering 68.79 m t additional production. The major food grains like wheat (113.29 m t) and rice (137.82 m t) recorded the ever highest production during 2023-24 whereas maize (37.66 m t), sorghum (47.37 m t), oilseeds (39.69 m t) and Shree Anna (17.57 m t) also did well. The major technological supports for such increase have been more availability of quality seeds of recently released 2235 high yielding varieties or hybrids having resistance against major diseases and short duration; and integrated crop management technologies besides policy support in terms of Pradhan Mantri Fasal Beema Yojna, investment in microirrigation, remunerative minimum support price for major crops and indicated procurement on it for many crops etc. Similarly, during last 10 years, more than 1625 varieties and hybrids of horticultural crop have been released and horticultural production attained new heights as per third advance production estimates (353.18 m t) of 2023-24. The higher production of food grains and horticultural crops helped country in attaining self sufficiency in production of several crops and commodities. The country has done a good job as India ranks first in milk production, 2nd in Egg production, 2nd in fish production and 5th in meat production. The impressive growth in milk, egg, fish and meat production has been seen.

Growing food demand: India's annual food production will need to increase to feed the ever growing population (1450 million in 2024) from current level of food grain production i.e. 332 m t (2023-24) up to ~400 m t by the year 2050. To sustain current level of availability of food and feed etc. the pressure will increase to produce more from fix land. Even the unplanned urbanization and requirement of land for non-agricultural use will further increase pressure to improve productivity of the agri-horticultural crops and commodities. To meet the projected demand, there is urgent need to reorient research and development plans for sustainability of the agricultural production base, and enhance production to feed additional population with is set to increase.

The agriculture is **facing a numerous challenges** due to climate change which can be witnessed in form of abrupt increase or drop in temperature, reducing number of rainy days, heavy downpour, untimely frost and hails etc. The excessive use of irrigation water, fertilizers and other agri-inputs the total factor productivity is also declining in some of the states known as 'food bowl'. Similarly, with the increase in living standard and increasing income of the people, particularly of upper middle class and rich, the demand for quality food is increasing day by day. To meet the growing demand for food globally, we have to develop and execute robust research, development and policy framework. There is need to create awareness among policy makers that overnight investment in research and development is not going to help. And if you invest today, the fruits of research and development efforts will ready for harvest tomorrow. The complacency that we have enough food and our farmers can produce the required quantity in future without technology breakthrough may be very difficult, if not impossible, let it be any policy support or subsidy or incentive. Many Institutes of Indian Council of Agricultural Research (ICAR), agricultural universities (AUs) and other academic institutions have state of art facilities. There is need to capitalize over their capabilities.

More recently release of a number of **climate resilient and biofortified varieties** has paved the way for the development of technologies including varieties of agri-horticultural crops to sustain agricultural production in future. We have to care for framers, consumers and industry' preferences while developing crop varieties or other technologies. The new initiatives in identification of trait specific donors having known genes or quantitative trait loci (QTLs) controlling desired traits has opened doors for development of climate smart varieties with higher order of precision in transferring genes/QTLs and selection from large segregating populations. The already available traits specific and well characterized genetic resources and genomic resources being developed have vast potential in crop breeding research. The release or generation of genetic variability using primitive landraces through conventional breeding techniques to utilization of crop wild relatives (CWR) from secondary or tertiary gene pool of even from different species offer vast potential. The development of transgenic and genome edited genetic resources will help in enhancing per se genetic yield potential of future crop varieties. The higher genetic gain from future breeding programmes can be achieved through speed breeding where seed to seed cycle can be reduced and 4-5 generations can be advanced in a year saving 4-5 years time for the development of newer varieties. The laboratory based techniques alone are not going to resolve the issue of higher production and productivity. We have to develop



permutations and combinations followed by precise selection to have varieties with higher genetic yield potential. This warrants that we must invest in capacity building for the development of hard core breeders who can easily embrace newer tools and techniques as well.

The **natural resource management** is prime area where lot of research has to be done with respect to underground parts, particularly root architecture to explore soils for more nutrients, root rhizosphere for microbes those help in mineralization of fix nutrients through different ways etc.. The precision agriculture, conservation agriculture, regenerative agriculture, organic and natural farming etc. are being talked about. There are many associated issues with these practices which need to be addressed through investment in R&D. The potential of microbes and underground plant parts need to harness in developing practice for natural farming. The crop residue recycling and technologies for rapid decomposition of plant waste and residue can help in carbon sequestration and help in improving soil organic carbon. Similarly, efforts will be required to enhance nutrients acquisition and use efficiency besides improving water productivity. As a policy, there is need to delineate irrigated area as assured irrigated area and other area where only life saving irrigation is available. This will help in development of remunerative cropping systems for sustainable agriculture.

The **crop management** strategies for minimizing losses due to weeds, diseases and insect pests etc. need a fresh look. In view of changing agricultural practices like organic or natural farming, conservation and regenerative agriculture, protective cultivation, soilless farming etc., the integrated pest management strategies are to be developed those are ecofriendly and cost effective. A network of the mobile plant health clinics and plant doctors need to be created to minimize losses due to diseases and insect pests through on-farm diagnostic and real time advisories.

The **farm mechanization** may help in minimizing losses due to weeds and delay in seeding or harvesting. Development of small farm machinery may help in this direction. Post harvest management and value addition is of utmost importance to save the produce. Public-private-people participation is required to ensure reduced damage after harvest and in processing and value addition. The solar energy operated farm machinery may also help in bringing sub-marginal lands under agro-forestry systems. **Digital agriculture** is another area where country has to invest and create awareness. The sensor based application of the irrigation, fertilizers, use of drone in foliar spray of agro-chemicals, issuing real time agro-advisories; remote sensing based crop loss assessment, crop health monitoring and surveys, etc. are set to revamp future agriculture.

There is need to discuss science led technologies development strategies and prepare robust executable plans for different agro-ecologies. With the kind of advancement in science is taking place, Indian agriculture is set to produce more food and sustain agricultural production base.



ADVANCED BREEDING TOOLS AND STRATEGIES FOR THE DEVELOPMENT OF CLIMATE RESILIENT MAIZE CULTIVARS

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Introduction

Maize is one of the most important and widely grown crops in the world. It is the leading cereal crop of the world with 1.23 billion metric ton production (Anonymous, 2024). Globally, maize is grown on 188 million ha in more than 170 countries with 1230 million MT of production (Anonymous 2024). Maize is used for multiple purposes as food, feed, fodder, edible oil, biofuel and raw material for various industrial products. Maize is a major source of feed and industrial products in the high-income countries, it provides food, feed, and nutritional security in the world's poorest regions in sub-Saharan Africa (SSA), Asia, and Latin America. United States of America (USA) is the major producer and contributor (32. %) of maize whereas; India stands on 6th position in terms of production with 9.2 million ha and annual production with 37.5 million tons (Anonymous, 2024). Further, it is an important industrial raw material where more than 3000 products are being made from it providing wide opportunity for value addition. Being an international crop, its demand is increasing day by day. Across the low- and middle-income countries, the population is projected to double by 2058 (UN World Population Prospects 2019). To meet the demands of the ever-increasing population, maize production must increase by 2.2% per year. In India the demand of maize is on increasing trend due to its policy support and utilization of maize grain in ethanol production. To meet the E20 target of ethanol blending in petroleum up to 2025-26 a 9.2 million metric tons maize is required to produce 350 crore liter ethanol. However, sustaining maize yield stability over the year and locations is the big challenge in the era of climate change. Abiotic stress like drought, cold, heat, water logging, salinity and climate change are some of the major factors that reduce the agriculture crop production considered major threats to global crop production. (Singh *et al*, 2024). These abiotic stresses (drought, heat, cold waterlogging and salinity) drastically reduce plant biomass, yields and survival of major food crops up to 70% (Meena *et al.*, 2017a). The plant growth and development stages are disturbed by these climatic aberrations and therefore prevent the plant genotype(s) from realizing their full genetic potential (Waqas *et al.*, 2019). Over the last three decades, climate variability has resulted in a reduction in global maize production by 0.17 MMT per year, translating to an annual 0.7% decrease in consumable food calories available from maize globally (Ray *et al.* 2019). Climate change is further projected to reduce maize yields by an average of 7.4% for every 1 °C increase in mean global temperature (Zhao *et al.* 2017). Maize yield losses from insect pests are estimated to increase by 10–25% for every 1 °C warming through increased population growth and metabolic rates (Deutsch *et al.* 2018). The cutting-edge genomic technologies, advanced breeding tools, innovative agronomic practices, and climate-informed decision support systems can be used and the impacts of climate stress on maize production can be mitigated by stakeholder collaboration and more resilient and sustainable agriculture can be acquired.

Advanced breeding strategies

To design and implement advanced breeding strategies for developing abiotic stress tolerant maize genotypes, new tools and technologies like use of wild and distant germplasm, doubled haploids (DH), whole genome sequencing, high-density genotyping, high-throughput phenotyping, genomics-assisted breeding (rapid-cycle genomic selection, marker-assisted recurrent selection), and crop modelling play a greater role (Prasanna *et al.*, 2021). Now new tools and techniques like genomic selection and rapid generation advancement, DNA/ RNA sequencing, high-throughput genotyping/phenotyping, trait mapping, functional characterization etc. are now available to speed up the breeding process (Nepolean *et al.*, 2018).

1. Introgression and utilization of distant and wide germplasm for Climate resilient traits

Addressing the challenges posed by climate change requires innovative strategies in maize breeding, particularly through the incorporation of wild relatives. These wild species, often resilient to extreme conditions, harbor genetic traits that could enhance the adaptive potential of maize crops. Use of maize wild relatives in pre-breeding programme can also contribute significantly for developing stress resilient germplasm. Various gene banks have conserved approximately 0.05 million maize accessions. CIMMYT also conserved approximately 28,000 accessions. Such a huge maize germplasm consisting of pools populations and wild relatives may be the source of large unexploited genetic diversity as well as source of new traits and alleles. Teosinte a wild relative of maize has many subspecies of *Zea mays* and some species identified as good source of



useful source for improvement of abiotic stress tolerant traits e.g., teosinte *Z. luxurians* and *Z. mays* ssp *huehue-tenangensis* can be used as source of genes for adventitious root formation under extreme waterlogging. Introgression lines of maize were developed genomic regions from teosinte (*Z. mays* ssp *Nicaraguans*). Physiological analyses revealed that *Tripsacum*'s exceptional drought resistance was attributed to its high photosynthetic rates and water use efficiency (Kemper et al., 1998). Subsequent studies demonstrated that maize cultivars introgressed with *Tripsacum* grow better under drought stress than modern maize. These introgression lines indicated superior root systems that penetrated deeper into the soil and had higher GY than contemporary maize cultivars (Gitz III et al., 2013).

2. Molecular Breeding Approaches for Climate resilient traits

Molecular tools to enhance breeding efficiency and effectiveness have become integral to many maize research programmes worldwide. Marker-assisted breeding (MAB) can be used to improve maize varieties for stress tolerance by Identifying molecular markers. These markers should be linked to the traits of interest, such as abiotic stress resistance. Using linkage mapping this method involves constructing a mapping population to isolate and screen for linked markers. Molecular markers can include single nucleotide polymorphisms (SNP), sequence-characterized amplified regions (SCAR), and simple sequence repeats (SSR). The marker-assisted selection (MAS) method can be used to improve grain yield under abiotic stress conditions. The marker-assisted recurrent selection (MARS) method can be used to improve drought tolerance and grain yield. The ideal DNA markers should have characteristics such as high polymorphism, even distribution across the genome, and cost-efficient marker development. The genetic regulation for drought tolerance is dependent on stress intensity. Stress tolerance is a polygenic trait controlled by many genes, and most of these genes have minor effects. SSRs are the most widely used markers by maize researchers due to their availability in large numbers in the public domain. Marker-assisted backcross breeding (MABC) is a molecular breeding technique that can be used to improve maize varieties for stress tolerance. MABC uses molecular markers to identify and select genes that control resistance to factors like drought or heat. In foreground selection the method uses markers linked to the target genes to identify individuals most similar to the recurrent parent and in recombinant selection it selects progenies with target genes after back crossing. Whereas, in background selection it uses markers not linked with the target loci to select backcross progenies with the best extent of recurrent parent genome. MABC can speed up the backcross process and reduce the number of backcross generations required, identify rare individuals resulting from recombination close to the desired gene and also minimize linkage drag. MABC has been used to Improve grain yield under drought conditions in tropical maize, Improve maize resistance to qMrdd8.

3. Genomic Selection

Genomic selection (GS) is a method used to improve stress tolerance in maize by identifying genomic regions associated with stress. Genome-wide association studies (GWAS) have identified thousands of genomic regions in maize that are associated with many types of stress. Different GS models have been used to predict genotypes under drought stress. Some of the most efficient models include rrBLUP and BSSV. GS has been shown to be more accurate for predicting full-sibs than unrelated crosses. GS can be used across breeding cycles, within breeding cycles, or with untested parents. GS can reduce the length of the breeding cycle, minimize phenotyping costs, and accelerate genetic gains. Stress tolerance is a polygenic trait, meaning it's controlled by many genes, each with a minor effect. Classical linkage or QTL analysis has had limited success in improving these traits. However, GWAS has been more successful in identifying genomic regions associated with stress. Shikha et al (2017) by using Bayes B model, and a set of the top 1053 significant SNPs with higher marker effects was selected across all datasets to validate the genes and QTLs. Out of these 1053 SNPs, 77 SNPs associated with 10 drought-responsive transcription factors. These transcription factors were associated with different physiological and molecular functions (stomatal closure, root development, hormonal signaling and photosynthesis). Singh et al (2023) used five-fold cross-validation method to select the best model among genomic best linear unbiased prediction (GBLUP), ridge-regression BLUP (rrBLUP), extended GBLUP, Bayesian Lasso, Bayesian ridge regression, BayesA, BayesB, and BayesC they concluded that GS is a promising approach for developing salt-tolerant maize cultivars and provides a roadmap for implementing GS in salinity-tolerance breeding programs. Shikha et al (2023) identified 6 significant haplotype blocks for grain yield under cold stress across the test environments. Haplotype blocks particularly on chromosomes 5 (bin5.07), 6 (bin6.02), and 9 (9.03) co-located to regions/bins that have been identified to contain candidate genes involved in membrane transport system that would provide essential tolerance to the plant. The regions on chromosome 1 (bin1.04), 2 (bin 2.07), 3 (bin 3.05–3.06), 5 (bin5.03), 8 (bin8.05–8.06) also harbored significant SNPs for the other agronomic traits.



4. Genome-wide association studies (GWAS)

Genome-wide association studies (GWAS) are a powerful tool for identifying the genetic basis of complex traits in maize. Maize is an excellent crop for performing GWAS due to diverse genetic variability, rapid decay of linkage disequilibrium, availability of distinct sub-populations and abundant SNP information. The application of GWAS in maize has resulted in successful identification of thousands of genomic regions associated with many abiotic and biotic stresses. GWAS can be used to identify genetic loci and potential genes associated with traits. GWAS can be used to identify SNPs responsible for moisture, protein, oil, starch, and lysine contents in maize kernels. GWAS can be used to identify loci associated with kernel length, width, thickness, and hundred-kernel weight. GWAS can be used to identify genomic regions associated with abiotic and biotic stresses. Tolerance of maize plants to abiotic stresses such as drought, water submergence, salt and heavy metals have been studied using GWAS. ‘Omics’ approach (Gong *et al.* 2014) revealed a series of genes involved in cold stress response, e.g., ZmDREB2A, ZmCOI6.1, ZmACA1, ZmERF3 (Nguyen *et al.* 2009), ZmPP2C2 (Hu *et al.* 2010), ZmMKG4 (Kong *et al.* 2011), ZmFKBP (Yu *et al.* 2012) and ZmMKG1 (Cai *et al.* 2014). Several candidate genes, viz., ZmVPP1 encoding drought tolerance (Wang *et al.* 2016c), GRMZM2G013726 encoding anthocyanin synthesis under low phosphorous condition (Xu *et al.* 2018a) and GRMZM2G377194, GRMZM2G026892, GRMZM2G060349 and GRMZM2G122199 associated with thermo-tolerance (Gao *et al.* 2019) have been identified.

Identification and cloning of major candidate genes through GWAS in maize: SNPs and QTLs governing various important traits in maize have been identified by GWAS. Recently, some progress has been made in functional validation of detected allelic variants, e.g., fatty acid desaturase 2 (*fad2*) is the first candidate gene in maize studied by GWAS (Belo *et al.* 2008). Recently candidate genes Zm00001d034319 and Zm00001d039219 associated with cold tolerance have been identified by integrating GWAS and RNA-seq data in maize (Zhang *et al.* 2020). Integrating GWAS and co-expression analysis, gene Zm00001d002266 (encoding lysine-specific histone demethylase) and *Zm00001d049584* (encoding a wall-associated receptor kinase) governing the expression of seedling root length in response to drought stress has been reported by Guo *et al.* (2020).

5. Rapid cycle genomic selection climate resilient traits

Rapid cycle genomic selection for abiotic stresses could increase genetic gains in stress tolerance breeding by two- to three folds. Rapid cycle genomic selection (RC-GS) helps to shorten the breeding cycle and reduce the costs of phenotyping, thereby increasing genetic gains in terms of both cost and time. Rapid cycle genomic selection (RC-GS) was reported an effective breeding strategy in tropical maize multi-parental breeding populations for simultaneously conserving genetic diversity and achieving high genetic gains in a short period of time (Zhang *et al.* 2017). In a recent report, Das *et al.* (2020) suggested that genomic selection for drought and waterlogging tolerance resulted in no yield penalty under optimal moisture conditions. The genetic diversity of the two populations did not change significantly after two cycles of GS, suggesting that rapid-cycle genomic selection can be used as an effective breeding strategy to achieve high genetic gains without losing genetic diversity.

6. Phenomics: High-throughput and precision phenotyping for climate resilient traits

Phenomics has been extensively used to monitor diseases, pest infestations, drought stress, nutrient status, growth, presence of weeds and yield under stresses and normal conditions in different crop species. Technological advancement has made novel imaging techniques available for use in HTP. Imaging techniques range from handheld mobile phones to highly flexible drone imaging using unmanned aerial vehicles (UAV). UAVs offer a platform that rapidly records data using different imaging sensors over large areas and potentially gives images with high spatial resolution. UAV can be used to cover plots or multiple fields in one flight, but their limited battery capacity reduces their utility for very large-scale HTP. Remote sensing using satellites imagery has been extensively used in assessing plant stresses since the early 1970s (Saini *et al.* 2022; Sishodia *et al.* 2020). Reliable, automatic, multifunctional, and high-throughput phenotypic technologies are increasingly considered important tools for rapid advancement of genetic gain in breeding programs. Phenotyping is an integral part of the stress breeding that contributes in understanding of the genetics of stress tolerance and better product development. Phenotyping is necessary to improve the selection efficiency and reproducibility of results. To improve the efficiency of molecular breeding, reliable, automatic, and high-throughput phenotypic technologies always needed. Most of the abiotic stress tolerance are quantitatively controlled, therefore for improving the accuracy, precision phenotyping has acquired much attention to improve the heritability of the traits. Selection of primary and secondary traits associated with stress tolerance provides the way for the



development of stress tolerant maize. ASI, root architecture and stay green traits are the important secondary traits to impart drought tolerance whereas, brace roots, chlorophyll content, and % of stem and root lodging are important traits for waterlogging tolerance. (Nepolean *et al.*, 2018). Precision phenotyping is a challenging task for selecting direct and indirect traits in stress breeding programme. Stress associated primary and secondary traits of plant architecture could be phenotyped precisely under controlled stress conditions through newly emerged high-throughput and nondestructive techniques. Imaging techniques are widely used to phenotype the traits of maize. These have been used to phenotype the whole or specific part/s of the plant. Visible light imaging for whole part of the plant thermal imaging for whole shoot or leaf tissues near infrared imaging for whole part of the plant and 3D imaging for shoot have been reported in maize (Nepolean *et al.* 2018). The frequently used phenotyping index, such as leaf length, leaf area, and fruit volume, could be obtained in phenotyping platforms in simple method (Zhang *et al.*, 2017). However, smartphone-based app platform was developed for field phenotyping by taking pictures and image analysis at organ level. Researchers using high resolution 3D scanners to acquire the morphological structure of plant organs although, high resolution 3D scanners are relatively expensive but morphological data are more accurate. Advancement in automation, robotics, new sensors, and imaging technologies (hardware and software) have provided an opportunity for high-throughput plant phenotyping platforms (HTPPs) development (Gennaro *et al.* 2017). Using advanced information technology, digital technology and platform equipment with plant phenotyping, several HTPPs in growth chamber or greenhouse have been developed. These high-throughput phenotyping platforms are characterized by automation, high-throughput, and high precision, which greatly improve plant data collection efficiency and accuracy, in order to improve the efficiency of crop breeding (Zhang *et al.* 2018).

7. Speed Breeding

Speed Breeding (SB) shortens the breeding cycle and accelerates crop research through rapid generation advancement (RGA). The SB can be carried out in different ways, like extending the duration of the plant's daily exposure to light combined with early seed harvest, thereby reducing the generation time. The basic principle used in SB is involves the modulating of the optimum light (quality/intensity) to extend crop photoperiod using supplementary lighting with sodium vapor lamps (SVL) or metal halide and light-emitting diode (LED) lighting (Singh *et al.* 2021). The key altering factor in speed breeding are light, temperature, humidity and photoperiod. An appropriate spectral range of light (400-700 nm) can be achieved through light-emitting diodes (LEDs) or other lighting sources as halogen lamps or sodium vapor lamps (SVLs). In addition to controlling light quality, light intensity should also be taken care of, so the recommended photosynthetic photon flux density (PPFD) of ~450–500 $\mu\text{mol}/\text{m}^2/\text{s}$. Normally recommended photoperiod of 22 h with 2 h of darkness in a 24-h diurnal cycle is adequate. The optimal temperature regime (maximum and minimum temperatures) should be applied for each crop. A reasonable range of 60–70% humidity is ideal and for crops adopted in drier conditions, can apply a lower level. For most of the important crops, SB protocols have been developed to harness the rapid generation advancement (Hickey *et al.* 2019). This approach reduces the generation time by 5 and 2.5 in comparison to field and glasshouse conditions, respectively (Snedecor 2020). For crops like wheat, rice, soybean, barley, sorghum, rapeseed, millets, peanut, sugarcane, potato, and tomato, generation time has been shortened rapidly by manipulating light intensity, day length, and temperature, etc. In comparison to a glasshouse with a natural photoperiod, where only 2-3 generations of wheat, barley, chickpea, and canola can be achieved per year, SB enables 4-6 generations of these crops to be grown in a year. Early harvesting and then drying in an oven/dehydrator (~3days) also further fasten seed cycling compared to the normal seed ripening process, which takes about 15 days. Although it lowers the grain weight but seed viability remains unaffected (Hickey *et al.* 2019). The integration of SB in maize breeding presents new opportunities to elevate maize production to unprecedented levels. It facilitates the expeditious advancement of inbreeding and crossing programs, enabling the development of diverse recombinant inbred lines (RILs) mapping populations and identifying genomic regions linked to target traits. Moreover, SB contributes to the efficient establishment of marker-assisted backcross breeding (MABB) in maize, significantly shortening the seed-to-seed cycle and accelerating the selection of maize genotypes for kernel quality traits, thereby bolstering the maize breeding program's mutation breeding initiative. Integrating genomic selection with SB emerges as a strategic approach to optimize maize breeding cost-effectively.

8. Accelerated line development using Double Haploid (DH) technology

The line development is an important component of maize breeding programs. The conventional pedigree and bulk method of inbred line development in maize involve 7 to 8 generations of recurrent selfing and selection to reach the desired and complete level of homozygosity which is time consuming process. DH technology produces completely homozygous lines in one step from the source germplasm, usually a biparental cross or a population. DH lines can be developed by both in vitro and in vivo methods. However, in maize in vivo methods have proved more reliable and are commonly used in large-scale



production of DH lines (Chaikam *et al.* 2019). DH technology allows the homozygous inbred lines development in a single year as compared to three to four years in with the conventional inbreeding and recurrent selfing method, when using off season nurseries. Therefore, it is the fastest and efficient method to produce completely homozygous inbred lines. DH technology not only useful to derive homozygous lines but it is recently being used for exploring the genetic diversity in maize landraces, for safeguarding genetic resources and introducing novel variation to expand the genetic base of elite germplasm. In *vivo* DH technology has been adopted by many commercial maize breeding programs in Europe, North America, and China (Molenaar and Melchinger 2018). International Maize and Wheat Improvement Centre (CIMMYT), in collaboration with the University of Hohenheim, making the DH technology accessible to both public and private sector organizations. In recent years, improved maize hybrids with DH lines as parental lines have been released in Africa (Chaikam *et al.* 2018). The development of haploid inducer lines with high haploid inducer rate (HIR) opened the way for in *vivo* DH lines development and almost all DH production pipelines in the maize breeding programs of multinational companies are now based on in *vivo* haploid induction. The first haploid inducer line was “Stock 6,” produced maternal haploids at a frequency of 1–3%, and that was the highest haploid induction rate (HIR) at that time. Thereafter using Stock 6- several inducers were developed with good field performance and HIR. Most of these inducers like UH400, RWS and PHI were adapted to temperate environments. CIMMYT in collaboration with the University of Hohenheim developed the first-generation Tropically Adapted Inducer Lines (TAILs), which have superior agronomic performance compared to temperate inducers as well as an acceptable HIR of 6–9%. Now CIMMYT has developed second-generation TAILs with much higher HIR (9–14%) and better agronomic performance (Chaikam *et al.* 2018).

9. Advanced Genetic Manipulation Technologies in Developing Stress Resilient Maize

9a. Gene Editing

Gene manipulation of the key transcription factors can be done to increase or decrease their expression, alter the nature of expression by changing promoter DNA, making the expression respond to a particular regulator etc. This can be done in cis-or trans-approach, depending on whether the gene from a maize itself or from some other species has been taken, respectively. Gene editing involves deliberately introducing knock-in/knock-out mutations, where either the amino acid sequence is changed or the protein expression is shut down. Although many systems exist for introducing specific changes in DNA, one system CRISPR/Cas9 has gained popularity. CRISPR stands for Clustered Regularly Interspaced Short Palindromic Repeats. These are genetic elements, which originate from viral genomes and have got incorporated into the bacterial genome. Endonuclease proteins are associated with these genetic elements, referred to as CRISPR-associated proteins or Cas. The RNA of viral DNA incorporated into bacterial genome, directs Cas proteins to act like specific endonuclease. Whenever, a viral genome is encountered in the cell, bacteria respond by engaging the Cas protein specific for that virus, resulting in cleavage of viral nucleic acid. This phenomenon has been used to design plasmid containing CRISPR Cas systems for precise editing of plant genomes. In maize gene editing successfully utilized to alter five genes *liguleless1* (LIG1), male fertility (Ms26 and Ms45), and acetolactate synthase (ALS) genes (ALS1 and ALS2) through targeted mutagenesis, and site-specific gene insertion using Cas9 and guide RNA. Using integrated multiplexed CRISPR/ Cas9-based approaches Liu *et al.* (2022) successfully targeted 743 genes. Researchers have successfully edited the *stiff1* gene, a negative stalk strength modulator, via CRISPR-Cas9. The edited allele with a 2 bp deletion and frameshift mutation conferred stronger stalks in the edited plants, which allowed enhanced-density planting and prevented lodging (Zhang J. *et al.*, 2020). Furthermore, recently researchers have also generated Semi dwarf maize plants by editing the *ZmGA20ox3* gene via the CRISPR-Cas9 technology. These varieties are suitable for high-density planting and have improved lodging resistance, indicating the development of new germplasm with enhanced stress tolerance (Zhang *et al.*, 2020.) Recently, scientists edited the promoter sequence of the *ARGOS8* gene to upregulate its expression, which resulted in enhanced GY under drought conditions (Shi *et al.*, 2017). CRISPR-Cas has, therefore, become a hotspot technology for the establishment of novel germplasm sources for breeding stress-tolerant maize varieties. By precisely editing key genes and regulatory regions, researchers can develop maize lines with improved tolerance to various abiotic stresses, ensuring stable and high yields under challenging environmental conditions. Scientists have also successfully established a CRISPR/dCas9-based toolkit for precise and effective activation of specific target genes in maize (Qi *et al.*, 2023). Moreover, this toolkit allows precise control over gene expression levels by targeting specific promoters or regulatory regions, without introducing foreign DNA into the plant's genome.

9.b Virus-induced gene silencing (VIGS)

The VIGS is a powerful technology that utilizes a plant's natural antiviral defense mechanism which is mediated by RNA



(Huang *et al.*, 2012). When a plant is infected with unmodified viruses, this mechanism targets the viral genome. However, researchers have adapted this mechanism for functional genomics studies by introducing virus vectors carrying host plant genes derived inserts. In this case, the RNA-mediated silencing process is redirected to target the corresponding mRNAs of the host genes, effectively knocking down their expression. Several genes have been silenced via VIGS in maize. Cao *et al.* (2021) employed VIGS to investigate the role of ZmbZIP33 in maize. Silencing ZmbZIP33 expression (BMV-ZmbZIP33) reduced chlorophyll levels, abscisic acid (ABA) levels, decreased peroxidase and superoxide dismutase activities, as well as enhanced water loss rate and stomatal opening compared to the BMV control. These findings indicated that silencing ZmbZIP33 can reduce drought resistance and impair maize plants' recovery ability. Batool *et al.* (2024) utilized VIGS to investigate the function of the ZmWRKY36 gene in maize and revealed that silencing ZmWRKY36 can reduce chitin-triggered reactive oxygen species (ROS) production. This finding validates the positive regulatory role of ZmWRKY36 in the maize immune response. VIGS utilizes plant's natural antiviral defense mechanisms and has, therefore, become an invaluable tool for functional genomics research, enabling scientists to elucidate the roles of specific genes in plant development, growth, and stress responses.

9.c Multiplex genome editing

Small contributions of several genes determine important agronomic traits such as yield. Improvement of these complex quantitative traits requires hard and time-consuming selection and multi-crossing programs, which can take years before resulting in the development of new elite cultivars, even using modern techniques such as Genome Prediction, for example. CRISPR/Cas-based multiplex genome editing (MGE) enables the creation of new lines carrying multiple genome modifications in a few generations. This possibility represents an enormous advance over traditional plant breeding and transgenics, facilitating the stacking of advantageous traits (Najera *et al.*, 2019). MGE can be used to target similar and/or dissimilar sequences. For example, a single sgRNA can be used to target multiple genes with conserved regions (whereas more than one sgRNA can target multiple genes or even multiple sites on the same gene (Najera *et al.*, 2019). MGE was also used for targeting multiple genes in maize. Because most cultivated maize plants are hybrids, detasseling is important for preventing self-pollination. Thus, identifying potential genes leading to male sterility is of great interest. Although several homologs of such genes are already known in maize, they often belong to families comprising genes with redundant functions. Through an MGE approach, Liu *et al.* (2022) were able to identify genes that can lead to male sterility when knocked out either individually or in combination with others. This study opens the possibility of selecting specific combinations of gene knockouts for establishing commercial lines. Another interesting approach for MGE in maize has been recently described. The technique, dubbed BREEDIT, aims at improving complex traits controlled by many genes, such as drought resistance and yield. In BREEDIT, populations transformed with different sets of sgRNAs (twelve different sgRNAs on each set) are then crossed, stacking up mutations in an increasing number of genes. This approach is useful for both trait improvement as well as for the discovery of new genes contributing to a given trait of interest (Lorenzo *et al.*, 2022).

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WALNUT (*JUGLANS REGIA L.*) CULTIVATION IN INDIA

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Introduction

Walnut (*Juglans regia L.*), also known as “Akhrot” is an important nut crop with very good export potential. Most of the trees are of seedling origin with highly variable yield potential and nut quality. There are individual trees of very good plant and characteristics which can be multiplied only through vegetative methods of propagation. Walnut a member of Juglandaceae family is one of the finest nuts of temperate regions. It is the oldest cultivated fruit in the world and seedling trees of walnut are found growing in all parts of North Western Himalayan Region at 1200-2200 meters elevation and trees exhibit considerable variation in respect of vegetative growth and fruit characters. Also, as an oil yielding crop plant is very important for economic growth of the agricultural sector. The oilseeds containing unusual fatty acids are industrially important, as they are used in protective coatings, dispersants, pharmaceuticals, cosmetics, soaps and a variety of synthetic intermediates as stabilizers in plastic formulations. Walnut production is expected to gradually rise in the next 3-5 years, as new trees with improved varieties reach bearing age and as acreage is also increased. Per capita consumption is relatively negligible. “Pusa Khor” is being evaluated by the scientists of IARI Regional Station, Shimla. This particular accession has started bearing in the third year of its grafting. The walnut normally takes 10-12 years even more to come into bearing. The fruit appears to be borne in lateral position as well as terminally. This is characteristic of newly evolved early and heavy bearing walnut cultivars. However, no such cultivar is reported in India so far. It is semi-vigorous in growth habit. It is an early, regular; heavy bearing and good quality walnut collection in comparison walnut plants of comparable age are not bearing any fruit as yet. The oil percentage and shelling percentage recorded was 55.0 and 50.0, respectively. High development costs for establishing a walnut orchard demand the planting of cultivars that bear large crops at an early age. Lateral bearing walnut cultivars tend to be precocious and are better suited to high yielding, high density plantings.

The *Juglans* genus consists of 21 species and Persian walnut (*Juglans regia L.*) is the only species that widely cultivated for production of edible nuts for table purpose. Walnut is a high energy food, rich in oil including omega-3 fatty acids, vitamins and minerals and valued as healthy snack food and bakery ingredients (Rana *et al.* 2007). North-Western Himalayan region of India has significant Persian walnut (*Juglans regia L.*) trees, most of which are of seedling origin. The region has rich morphological, phenological, and carpological walnut diversity because of the large variability of native walnut, resulting from cross-pollination and seedling propagation. Persian walnut (*Juglans regia L.*) is an important and widely distributed cultivated nut species acclaimed for its timber and nutritious kernels (Bayazit *et al.*, 2007). It has originated in a wide belt of Asia, stretching from the Balkans to China (Vahdati, 2014). Walnut is a nutritionally valuable crop in high demand worldwide (Hassankhah *et al.*, 2017). It is included in the group of priority plants by food and agriculture organization (FAO) (Raja *et al.*, 2017). Furthermore, it has medicinal importance, derived from its high antioxidant capacity and omega –3 fatty acids (Rahimipناه *et al.*, 2010). In India, north-western Himalayan region comprising Jammu, Kashmir, Leh-Ladakh, Himachal Pradesh, and Uttarakhand produces a major portion of the whole walnut in which Jammu and Kashmir produce the highest quantity and best quality walnuts where as north –eastern Himalayan region states Sikkim, Arunachal Pradesh, W.B. also produce to some extent walnut. Walnut is monoecious, bearing male and female flowers separately on the same tree (McGranahan and Leslie, 1990a, McGranahan and Leslie, 1990b). It is self-compatible, but with the most common protandry and sometimes, protogyny (Mert, 2010), the cross-pollination rate remains high (Luza and Polito, 1988). Because of its high allelic diversity and seed propagation, there has been increasing diversity over the years in walnut native areas (Wu *et al.*, 1999, Yang and Yang, 2005, Shah *et al.*, 2020) in nuts size, shape, thickness, and colour of the shell, quality, and colour of the kernel and other morphological attributes (McGranahan and Leslie, 1990a, McGranahan and Leslie, 1990b). An ideal walnut cultivar must have late leafing, both terminal and lateral bearing, low incidence of pistillate flower abscission, relatively smooth shell, 50% kernel recovery, plump and light-colored kernel, high yielding nuts (6 MT/ha) with large size, and at least moderately resistant to pests and diseases (Cosmulescu *et al.*, 2010, Botu *et al.*, 2010, McGranahan and Leslie, 2012). Walnut? breeding is important for developing new cultivars through hybridization, although it is both time consuming and cumbersome. Furthermore, the collection, evaluation, and identification of superior genotypes from existing populations are prerequisites in any walnut-breeding programme (Botu *et al.*, 2010). Therefore, it is convenient to exploit existing variability by making appropriate selections based on ideal characters such as late leafing, lateral bearing, precocity, high



productivity, nut and kernel quality, and resistance to major diseases. Western Himalayan region of India provides agroclimatic conditions suitable for producing high quality walnuts. Jammu and Kashmir State of India produces major share of export quality walnut. The nuts brought to market are generally a mixture of variable size and shape as they are harvested from different seedling tress (Sharma *et al.*, 2014). Based on the observed differentiation of variation, it is concluded that the magnitude of phenotypic variation in the population under study is high and the implication of the results will play a vital role in future walnut breeding programmes.

Persian Walnut is known to be rich in oil, vitamins, minerals and proteins (Ozcan, 2009, Özcan, Ýman, & Arslan, 2010 and is mostly produced in orchards in temperate zones like Turkey, China, Iran and USA (Erturk & Dalkilic, 2011; FAO, 2013). Different *Juglans* species originated on several continents, while the Persian walnut is native to temperate regions in mountainous Eastern Europe and central Asia, extending from Turkey, Iran and western China eastward to the Himalayan regions in India and Nepal (Leslie & McGranahan, 1998). All *Juglans* species are monoecious, with catkins being borne laterally on one-year-old wood, and pistillate flowers borne terminally or laterally (newer cultivars) on current season's wood. Although walnuts are genetically self-fruitful they exhibit the phenomenon of dichogamy, being either protandrous or protogynous depending on cultivar. Hence, walnuts are mostly cross-pollinated by wind (Polito, 1998). The walnut is regarded as highly valuable by an increasingly health conscious world due to various health benefits, including a great source of vitamin E and omega-3 fatty acids, as well as the ability to lower the level of cholesterol in human bodies (Savage *et al.*, 2001).

Older orchards in most traditional walnut producing countries including India consist of mature seedling trees characterized by a long juvenile period and poor, inconsistent bearing habits. This is due to the fact that the Persian walnut is more difficult to propagate vegetatively than any other tree nut species (Lagerstedt, 1979; McDonald, 1987; Reil *et al.*, 1998; Hartmann *et al.*, 2002). For a long time in the past, propagation through seed was only method available for walnut multiplication though this practice resulted into plants of great variability (Sharma *et al.*, 2003). Generally, walnut does not respond favourably to the vegetative propagation techniques under normal conditions, the way other temperate fruits do.

Walnut trees exhibit considerable variation in respect of vegetative growth and fruit characters. Use of this variability in the selection of superior seedlings with desirable traits will be of paramount importance in the expansion of walnut cultivation in this country. These seedling selections will not only produce nuts of desirable quality, but are also well adapted to the local climatic and soil conditions. Persian walnut is one of the most important nut crop grown in temperate region and produces edible nuts having higher nutritional value. In India there is no systematic orchards of walnut and trees of seedling origin are grown which exhibit wide intraspecific diversity for tree, foliage, floral, nut and kernel characters. The variation provides better opportunity for selection of unique walnut tree (s). Breeding new walnut cultivars through hybridization is both dif?cult and time consuming. Therefore, it is convenient to exploit existing variability by making appropriate selections based on characters like climatic adaptations, precocity, high productivity, good quality of nut and kernel and resistance to major diseases. Anthracnose disease affects all leaves, leaf petioles, shoots, nuts and peduncles, and has been reported to infect several cultivars of Persian (*J. regia*) as well as black (*J. nigra*) walnuts severely (Coates 2012; Michailides *et al.* 2012). Interestingly, the major share of walnut production comes from the trees of seedling origin, which has a lot of variability in nut size, shape, shell thickness and kernel quality (Berry 1997; Solar *et al.* 2002; Zeneli *et al.* 2005).

The Varieties used in India are CITH Nos., Pusa Khor, Chandler, Lara, Gobind, Wilson, Placentia, Eureka, Franquette, Lake English, Opex Caulchry, Drainovsky, Chakrata Selections, Kashmir Budded, etc.

Results and Discussion

A unique walnut plant is being evaluated at the IARI Regional Station, Shimla. It was collected from the Chamba region of Himachal Pradesh. This plant came into bearing in the second year of its grafting. The known varieties of walnut normally take 10 to 12 years and even more to come into bearing. The fruit appears to be borne in lateral position as well as terminally. This is a characteristic of newly evolved early, good quality and heavy bearing walnut cultivars. However, no such cultivar is reported in India so far. The leaf size and annual shoot increment (101 cm) is also much more less other walnut plants collected during the same survey. The fruit weight with husk was 58.85gm; whereas, without husk (nut) weight recorded 23.5 gm. The length of the fruit with husk recorded 61.80 cm where as, without husk (nut) it was 43.85 cm. The nut is thin shelled. Kernel colour is light yellow and good in taste.

The nut characteristics and bearing habit of the walnut selections from different districts of Himachal Pradesh recorded that Nut size index varied from 33.4mm to 57.2mm. Maximum recorded in Jubbal Selection whereas minimum exhibited in Lahaul



and Spiti Selection. Moderate nut size recorded in Kinnaur Selection, Kotkhai Selection and Chamba Selection. Dry nut weight ranged from 10.3g to 20.2g. Jubbal Selection recorded maximum followed by Chamba Selection (12.3g) whereas minimum was observed in Soghi Selection. Kernel ratio (%) also varied 41.4 % in Shimla Selection to 53.3% in Jubbal Selection followed by Chamba Selection (51.2%). Fruit weight varied from 97.20g to 31.24g. Maximum Fruit weight recorded in Jubbal Selection whereas minimum was exhibited in Rohru Selection. Moderate Fruit weight recorded in Kotkhai Selection, Kinnaur Selection, Lahaul and Spiti Selection and Chamba Selection. Nut Shell Thickness (mm) ranged from 1.15mm to 1.39mm. Maximum recorded in Kotkhai Selection and Lahaul & Spiti Selection whereas minimum in Soghi Selection followed by Chamba Selection (1.20mm). Both Lateral and Terminal bearing habit recorded in Chamba Selection only. Also Cluster bearing habit observed in Chamba Selection only.

Chamba selection came into bearing in the second year of its grafting. The seedling plants of walnut normally take 15 to 25 years to come into bearing. The fruit is borne in lateral position as well as terminally. Terminal bearing is associated with initiation of new growth early in the season which culminates in a mixed bud (with both floral and vegetative primordial). This is a characteristic of newly evolved early, good quality and heavy bearing walnut cultivars. However, no such cultivar is reported in India so far. The nut is thin shelled. Kernel colour is light yellow and good in taste. The oil per cent as well as shelling per cent recorded 55 and 50, respectively. An ideal nut should weigh between 12-18 g has a clean, strong and thin shell with tight seal and easily removable light kernel, clean and plump kernel weighing at least 50 per cent of the in-shell-nut (McGranahan and Leslie, 1990). According to Ramos *et al.* (1984) selection of clones that produce pistillate flowers on lateral buds has resulted in significant yield increases in Persian walnut, *Juglans regia*. Lateral bearing Persian walnut cultivars tend to be more precocious and are better suited to high yielding, high density plantings. Some eastern black walnut cultivars possess a characteristic known as lateral bud bearing (Sparks, 1982). These cultivars produce pistillate flowers on a profusion of short, spur type branches distributed along main scaffold limbs. With this growth pattern, both leaves and nuts are born throughout the tree canopy resulting in increased yield potential (Reid, 1996). The heritability of the lateral bearing characteristic is unknown for black walnut but Hansche *et al.* (1972) found this trait to have a moderate level of heritability in Persian walnut. An ideal walnut cultivar must have late leafing, both terminal and lateral bearing, cluster bearing, low incidence of pistillate flower abscission, high yielding nuts with large size, relatively smooth, 50 % kernel recovery, plump and light colored kernel and at least moderately resistant to pest and diseases (Cosmulescu *et al.* 2010; Botu *et al.* 2010; McGranahan and Leslie 2012).

In India, the maximum walnut trees are grown on own roots i.e. seedling origin. The evaluations conducted for all the 10(ten) walnut selections showed that 4 of them are vigorous in tree size, 5 selections have medium vigor and only one selection has low vigor. Phenological stages of the walnut selections have been recorded during the study period.

The dichogamy was not all the same in the selected trees. But, protandry was the most common among the studied trees. Most of walnuts have genetically protandry (Germain 1997). Ecological condition may effect on dichogamy in walnut (Sen 1998). A high variation of adaptation characters such as earliness and length of the flowering period and dichogamy offer the possibility of adapting the crop to diverse agro-ecological environments. Out of 10, 9 selections were terminal fruitfulness, so that all shoots from terminal generated female flowers and fruits. The Chamba Selection was mixed and had both terminal and lateral fruitfulness. Yield capacity is an important trait for economic walnut production. Productivity of walnut depends on flowering time and habit, fruit number on lateral and terminal shoots, lateral fruitfulness, nut and kernel weights, and kernel percentage (Hendricks *et al.* 1998).

Nut size is the determining factor for the market. Nut size index varied from 33.4 to 57.2 mm. Previous research (Cosmulescu and Botu 2012) in 109 walnut accessions of seedling origin growing naturally in Oltenia region of Romania showed the diversity of the fruit: nut length (28.20–49.70 mm) and nut diameter (25.70–40.60 mm). Nut weight is one of the most common important parameters influencing the quality. Dry Nut weight varied from 10.3 to 20.2 g. The highest value of nut weight among the studied accessions here (20.2 g) was less than nut weight reported by Sen and Tekintas (1992) for walnuts in Adilcevaz, Turkey (23.81 g); and more than nut weight by Ateş (2001) for walnuts in Kamal-Abad, Iran (20 g); Sharma and Sharma (1998) for Himachal Pradesh, India (18.60 g); Yarılgac *et al.* (2001) for east Anatolia, Turkey (17.04 g); Aslantas (2006) for North-eastern Anatolia, Turkey (16.01 g) and Cosmulescu and Botu (2012) for Oltenia region, Romania (18.40 g). Desirable nut and kernel weight should range from 12 to 18 g and 6–10 g, respectively, or kernel weight should be at least 50 % of the entire nut weight, and the kernel should have a light color (Arzani *et al.* 2008). Percentage of kernel is a feature of great importance in setting the number of selections and an important character for improvement. This character is related to nut and kernel weight. Accordingly, kernel percentage varied from 41.4 to 53.3 %. The higher the kernel percentage, the lower



the nut weight, while the ratio kernel/nut is higher and increases the value of the fruit. The highest kernel percentage (83.88 %) was lower than the data reported by Zeneli *et al.* (2005) (63.80 %), Aslantas (2006) (67.14 %), Arzani *et al.* (2008) (79.60 %) and Cosmulescu and Botu (2012) (71.70 %). Among all of the studied accessions, 204 accessions proved to be promising for new selections owing to higher kernel percentage i.e. [50 %]. Of them, accession no. 573 had the highest kernel percentage (83.88 %), followed by accessions no. 95 (71.82 %), 309 (68.91 %), 374 (68.91 %) and 539 (68.75 %). Walnut accessions with a kernel percentage higher than 48–50 % are more desirable (Germain 1997). It has been reported that fruit characteristics are not affected by tree age (Sharma and Sharma 2001). In the present study, kernel color in all accessions was very light to light. Generally, the most interesting accessions are those whose kernels can be easily removed from the shell and those whose kernels have a light color (Jubbal Selection, Chamba Selection, Kinnaur Selection and Soghi Selection. These traits have been used for selection of superior walnut genotypes (Sharma and Sharma 2001; Yarilgac *et al.* 2001; Zeneli *et al.* 2005; Aslantas 2006; Arzani *et al.* 2008; Cosmulescu and Botu 2012).

Out of 10 walnut selections, 9 have terminal bearing type, while those of Chamba Collection have intermediate bearing. Fruit size and weight varies very much from one selection to another. Walnut nut size is one of the main determinants for international trade. Nut Size Index (N.S.I.) as an average of the widest fruit width (D), narrow width (d) and height (h) have been used. The good quality walnut fruits of 9.0 to 10.0 g weight can be used for shelled market while those exceeding 11 grams can be used also for in-shell market. Another important element for defining the walnut quality is the percentage of kernel. In case of selections, the percentage of kernel ranged from 41.2% to 51.1%. Of the 10 selections, only 2 (Chamba Selection and Jubbal Selection) yields more than 50% kernel. Nut shell of the walnut selections is thin or medium (1.2 mm to 1.39mm in thickness). Taking into account the growth and fruiting characteristics of the walnut genotypes Chamba Selection, Jubbal Selection, Kinnaur Selection, Lahaul & Spiti Selection and Soghi Selection have been considered for further evaluation and direct use in the walnut farms, but only after clonal propagation.

Walnuts are widely distributed all over the world. World production of walnuts exceeds almost 1, 500, 000 metric tons. China, the United States and Iran are the major producers, with about 25%, 20% and 11% of total global production, respectively. In recent years, the production in these countries has increased rapidly (FAO 2006). Walnut has a high calorie level and rich nutrient composition. When it is consumed in sufficient quantity, it can significantly contribute to daily diet and has functional importance in medical biochemistry and physiology because of its specific compounds like polyunsaturated fatty acids. Walnut contains high levels of oil and it is consumed, fresh or toasted, alone or in other edible products. Their major constituents are triglycerides, in which monounsaturated (primarily oleic acid) and polyunsaturated fatty acids (linoleic and α -linolenic acids) are present in high amounts. The presence of other bioactive minor components, such as phenols, tocopherols and phytosterols, has been also documented (Martínez *et al.* 2006).

Conclusion

Several factors are important to consider when selecting a walnut cultivar including local climate and pest conditions. Walnut requires a period of winter chill to break dormancy and initiate leaf and flower production. Because pollination is required to set a crop, growers should select a cultivar with overlapping male and female flower maturity or, if a suitable pollen source is not nearby, plant a few trees of a pollinizer variety. Early leafing and flowering varieties are more exposed to spring rains that contribute to bacterial blight.

High development costs for establishing a walnut orchard demand the planting of cultivars that bear large crops at an early age. Cultivars displaying lateral bud fruitfulness generally come into production well in advance of non-lateral bearing cultivars. Shell thickness and structure are the most important determinant of percent kernel and nut crack-ability. The highest quality walnuts have a thin outer shell with no internal convolutions protruding into the nut meat. The inner shell partition between kernel halves should be very thin to allow easy removal of kernel pieces. An ideal walnut cultivar must have late leafing, both terminal and lateral bearing, Cluster bearing, low incidence of pistillate flower abscission, high yielding nuts with large size, relatively smooth, 50 % kernel recovery, plump and light-colored kernel and at least moderately resistant to pest and diseases. The Chamba Selection appear to meet this standard.

The north-western Himalayan region particularly Himachal Pradesh, India have important biodiversity of the *Juglans regia* L. species, wide variability, but increasingly subject to genetic erosion and genetic vulnerability pressure. Chamba Selection, Jubbal Selection, Kinnaur Selection, Lahaul & Spiti Selection and Soghi Selection have greater agro biological value similar to commercial cultivars and can be popularized after clonal propagation, into the new walnut orchards to be



established. The best selections were Chamba Selection, Jubbal Selection, Kinnaur Selection, Lahaul & Spiti Selection and Soghi Selection which had thinner shell, heavier kernel, light coloured kernel, more fruitfulness and late flowering. The most promising trees will be used to the benefit of conservation research, breeding and cultivation. Moreover, Chamba Selection could be used in high-density orcharding as well as export potentiality point of view.

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BRIDGING THE NUTRITIONAL GAP : RECOMMENDED PRACTICES TO MAKE AGRICULTURE NUTRITION SENSITIVE

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Abstract

Nutrient-sensitive agriculture (NSA) provides a comprehensive approach to tackling malnutrition by aligning agricultural practices with nutrition and health objectives. It focuses on producing nutrient-rich foods to combat hidden hunger and improve dietary quality, especially among vulnerable populations. NSA strategies include food fortification, biofortification, dietary diversification, and homestead gardening, all of which enhance access to essential nutrients. Examples such as iodized salt, vitamin A-enriched oils, and biofortified crops like iron-rich beans and zinc-fortified rice have shown significant potential in reducing micronutrient deficiencies. However, NSA faces challenges, including traditional farming methods, limited nutritional knowledge, economic limitations, and sociocultural factors that influence food choices. Overcoming these challenges requires targeted interventions like nutrition education, economic support programs, improved access to veterinary care, and community engagement to promote dietary diversity. Empowering women, who play a central role in household nutrition, is essential to addressing gender inequalities and fostering balanced diets. NSA also supports global initiatives such as the United Nations Sustainable Development Goals, particularly zero hunger and good health, by promoting sustainable food systems and building resilient communities. By integrating agriculture with health and nutrition, NSA offers a holistic solution to malnutrition and strengthens global efforts toward more equitable and healthier food systems.

Introduction

Malnutrition remains a significant global issue, disproportionately impacting children and women, particularly in developing countries like India, where access to diverse and nutritious diets is limited. Undernutrition contributes to nearly 45% of deaths among children under five and has lasting effects on health, cognitive development, and economic productivity (Black et al., 2013). Globally, one in five children under five experiences stunted growth, and 7.5% are affected by wasting, underscoring the seriousness of the problem. Similarly, anemia among women remains widespread, with 32.8% of women affected in 2016, a slight increase from 31.6% in 2000. Despite various efforts, progress in addressing malnutrition remains slow, leaving many countries off track to meet the 2030 Sustainable Development Goals (SDGs), especially those targeting childhood stunting, wasting, and anemia (Fanzo et al., 2018). The COVID-19 pandemic exacerbated these challenges by disrupting global food systems, deepening food insecurity, and risking a reversal of decades of progress in improving nutritional outcomes. Vulnerable populations, especially in countries like India, where malnutrition coexists with rising rates of non-communicable diseases (NCDs) such as obesity and diabetes, face a dual burden of health issues. These challenges make it increasingly difficult for nations to achieve SDG 2 (zero hunger) and SDG 3 (good health and well-being), which are essential for global development and the eradication of malnutrition in all its forms (Heidkamp *et al.*, 2021).

The consequences of malnutrition are multifaceted, extending beyond immediate health risks like increased susceptibility to infections and higher mortality rates. Long-term effects include impaired cognitive development, lower academic performance, and reduced economic productivity. Undernourished children often experience delays in cognitive development, limiting their educational achievement and future job prospects, thus perpetuating poverty and inequality, particularly in rural and marginalized communities. Prenatal malnutrition, a major issue in countries like India, leads to low birth weight, stunted growth, and an increased risk of chronic diseases later in life, further entrenching these disparities (Kramer and Allen, 2015). In this context, nutrition-sensitive agriculture (NSA) presents a promising solution to address the root causes of malnutrition. NSA integrates nutrition goals into agricultural policies and practices, using the agriculture sector not only for food production but also for improving the availability, affordability, and accessibility of nutrient-rich foods. This approach emphasizes dietary diversity and focuses on producing high-quality, nutrient-dense foods to combat both undernutrition and diet-related NCDs (Ruel *et al.*, 2018). By aligning agricultural systems with health and nutrition objectives, NSA offers a comprehensive solution to global malnutrition challenges, particularly in regions like South Asia and sub-Saharan Africa, where food security is fragile.



The importance of NSA has gained increasing recognition in global policy discussions and development agendas. The United Nations' 2030 Agenda for Sustainable Development emphasizes the need for transformative changes in food systems, with agriculture playing a central role in addressing hunger and malnutrition (United Nations, 2017). The EAT-Lancet Commission's 2019 report highlights agriculture's critical role in reshaping food systems to promote healthier, more sustainable diets and stresses the urgent need to close the gap between current consumption patterns and dietary recommendations (Sharma *et al.*, 2020). In India, for example, most people consume fewer than the recommended 2,503 kcal per capita per day, with nutrient-rich foods like fruits, vegetables, and proteins significantly underrepresented in diets (Sharma *et al.*, 2020). This disparity underscores the need for policies that promote the production and consumption of nutrient-dense foods across different socio-economic groups. NSA employs various strategies to achieve its goals, including crop biofortification, dietary diversification, and food fortification.

Among these strategies, biofortification stands out as a cost-effective and sustainable method to address micronutrient deficiencies by enhancing the nutritional content of crops through breeding and genetic interventions. Unlike food fortification, which adds nutrients to processed foods, biofortification increases the nutrient content of crops at the production level using conventional breeding or genetic modification. Crops such as vitamin A-enriched sweet potatoes, iron-rich beans, and zinc-fortified rice have shown significant potential in improving nutrient intake among populations suffering from hidden hunger. This approach ensures that essential nutrients reach vulnerable populations in their natural form, bypassing the logistical and infrastructural challenges associated with supplementation and fortification programs (Bouis *et al.*, 2019). For example, initiatives in India to promote iron- and zinc-enriched staple crops like rice and wheat have been vital in addressing widespread deficiencies in rural and low-income communities. While biofortification is central to NSA, it is complemented by other strategies aimed at improving nutritional outcomes. Dietary diversification, which involves increasing the variety of foods consumed, is considered the most desirable approach to combat malnutrition. However, in resource-poor settings, where economic constraints, crop seasonality, and low bioavailability of nutrients present significant challenges, dietary diversification may not always be feasible. NSA addresses these barriers by supporting the cultivation of a wide range of crops and livestock, improving both the availability and affordability of diverse, nutrient-rich foods (Shetty, 2018). In addition to enhancing food production, NSA also emphasizes the empowerment of women and youth, recognizing their essential roles in improving household nutrition. Women, in particular, are often the primary caregivers and decision-makers regarding food preparation and consumption. By increasing their access to resources, inputs, and income-generating opportunities, NSA can address socio-economic barriers that limit access to nutritious diets. This is particularly critical in rural India, where gender inequality and limited access to education and resources constrain women's ability to contribute to agricultural productivity and household nutrition. Empowering women through targeted interventions not only improves dietary diversity but also enhances health and well-being for entire families. Additionally, diversifying agricultural production to include more fruits, vegetables, legumes, and animal-source foods can greatly improve dietary quality and reduce dependence on nutrient-poor staples (Bamji *et al.*, 2011). This review aims to highlight the practices and strategies that can be adopted to make agriculture more nutrition-sensitive, contributing to improved health and well-being. By examining NSA's potential to drive positive change, we can better understand how agriculture can be leveraged to meet global nutrition challenges, particularly in rural and vulnerable populations. Ultimately, by aligning agricultural policies with nutrition and health goals, NSA holds the promise of creating resilient food systems that support sustainable development and enhance the quality of life for millions worldwide.

Strategies for nutrient sensitive agriculture

Dietary Diversification- a farm-based approach

Following the Green Revolution, India achieved remarkable self-sufficiency in staple cereals like wheat and rice. However, this agricultural shift largely overlooked nutrient-rich crops such as millets and pulses. While recent efforts are attempting to rectify this, the dietary habits formed during that time continue to prioritize staple grains. Despite advancements in other sectors—such as the White Revolution, which made India the world's largest producer of milk, and the Rainbow Revolution, which boosted fruit and vegetable production—nutrient deficiencies persist due to the limited micronutrient content of staples like rice and wheat. These deficiencies lead to “hidden hunger,” where individuals consume adequate calories but lack essential micronutrients like iron, zinc, iodine, and vitamins (Gani *et al.*, 2018).

Dietary diversification has become a crucial strategy to combat hidden hunger. This approach promotes incorporating a wider range of nutrient-dense foods, such as fruits, vegetables, legumes, dairy, and animal-source proteins, to address micronutrient



deficiencies and improve overall health. Unlike supplementation or food fortification, dietary diversification provides a sustainable and culturally appropriate solution, aligning with local food preferences. It not only enhances diet quality but also helps combat multiple nutrient deficiencies at once, supporting immune function and overall well-being (Jha & Warkentin, 2020). By focusing on both caloric adequacy and the balance of essential nutrients, dietary diversification offers a comprehensive solution for improving nutritional outcomes. It helps increase the intake of vital nutrients often lacking in staple-based diets. For example, legumes provide protein, fiber, and micronutrients like iron and folate; fruits and vegetables offer vitamins, minerals, and antioxidants; and dairy and animal-source foods supply bioavailable calcium, zinc, and vitamin B12. Together, these foods are crucial in addressing deficiencies, particularly in rural and low-income populations.

In India, initiatives like the National Food Security Mission and Poshan Abhiyaan have begun promoting the cultivation and consumption of diverse crops, including traditional grains such as millets. Millets are rich in iron, calcium, and dietary fiber, offering a practical solution to widespread anemia and other micronutrient deficiencies. Similarly, including pulses in school meal programs and public distribution systems has improved protein intake among vulnerable populations. However, these efforts need to be expanded to make a more significant impact on national nutritional health. Despite its benefits, implementing dietary diversification faces challenges, especially in low-income and resource-limited areas. A primary obstacle is the deep-rooted dependence on staple grains like rice and wheat, shaped by cultural preferences and government policies that prioritize these crops in food procurement and distribution systems. Changing these dietary habits requires extensive nutrition education campaigns highlighting the health advantages of diverse diets. These campaigns must be tailored to local contexts and sensitive to cultural beliefs to ensure communities embrace these dietary changes.

Another challenge is the presence of anti-nutritional factors in some foods. For instance, phytates found in legumes and grains can hinder the absorption of iron and zinc. Addressing this requires targeted strategies, such as promoting food preparation techniques (e.g., soaking, sprouting, or fermenting) that reduce anti-nutritional factors. Additionally, breeding programs can focus on developing crop varieties with lower levels of these compounds, ensuring that the full benefits of dietary diversification are realized.

Homestead gardening

Homestead gardening, also known as backyard gardening, involves growing vegetables, fruits, and sometimes small livestock near homes. This traditional practice plays a crucial role in nutrient-sensitive agriculture, particularly in low-income households, by addressing micronutrient deficiencies. It promotes dietary diversity, provides year-round access to nutrient-rich foods, and offers a sustainable solution to combat malnutrition and “hidden hunger,” where individuals consume enough calories but lack essential vitamins and minerals. One of the first initiatives to highlight the benefits of homestead gardening was a program led by the National Institute of Nutrition in Hyderabad and the All India Institute of Hygiene and Public Health in Kolkata. These programs focused on promoting vegetables rich in provitamin A, such as green leafy vegetables and orange- and yellow-fleshed crops, alongside nutrition education to combat vitamin A deficiency. The results were promising, with improvements in awareness, dietary intake, and reductions in conditions like night blindness and Bitot’s spots. This initiative demonstrated how homestead gardening could bridge the gap between agriculture and nutrition, laying the groundwork for similar programs in other regions (Vijayaraghavan *et al.*, 1997).

Research consistently shows that households engaged in gardening tend to consume more fresh fruits and vegetables, leading to improved intake of essential micronutrients like vitamin A, zinc, and iron. This dietary improvement directly addresses malnutrition and strengthens immune function, benefiting maternal and child health. Integrated systems that combine gardening with small-scale livestock rearing, such as poultry for eggs or milk from small ruminants, further enhance nutrition by providing high-quality protein and bioavailable micronutrients. These systems are especially beneficial during critical life stages, such as pregnancy and early childhood, when nutrient needs are elevated (Murty *et al.*, 2016).

Beyond its nutritional benefits, homestead gardening contributes to household food security by ensuring a reliable supply of fresh produce. In remote or economically disadvantaged areas where market access is limited or fruits and vegetables are costly, having a garden provides families with a sustainable and cost-effective source of food. It also reduces dependency on purchased foods and helps build resilience against seasonal food shortages. Additionally, cultivating indigenous and locally adapted crops promotes biodiversity and sustainable farming practices, as these plants often require fewer inputs like fertilizers and pesticides, making them well-suited for resource-poor households. Programs led by organizations such as the MS Swaminathan Foundation in India have showcased the transformative potential of homestead gardening. In regions like Wardha in Maharashtra and Koraput in Odisha, households that engaged in gardening reported significant increases in both



the frequency and quantity of fruits and vegetables consumed. Longitudinal studies conducted between 2014 and 2017 documented improvements in dietary diversity and reductions in micronutrient deficiencies. These successes underscore the role of homestead gardening in improving nutrition and empowering communities to take control of their food security (Bhaskar *et al.*, 2017).

Despite its many advantages, homestead gardening faces several challenges that hinder its widespread adoption. A key barrier is the lack of technical knowledge and access to essential agricultural inputs, such as quality seeds, fertilizers, and tools. While many households may have the space for gardening, they often lack the skills or resources to grow nutrient-dense crops effectively. Adverse climatic conditions, water scarcity, and pests further complicate gardening, especially in areas with limited agricultural infrastructure. Additionally, while gardens can provide a variety of foods, they may not meet all of a household's nutritional needs year-round. Complementary measures, such as nutrition education and access to diverse food sources through local markets, are often needed to ensure a balanced diet. Although homestead gardening is cost-effective in the long run, initial investments in materials and labor can be prohibitive for resource-poor families. To overcome these barriers, programs promoting homestead gardening should offer subsidies, community training, and support for locally adapted techniques that reduce costs (Pradhan *et al.*, 2018). By integrating gardening efforts with broader nutritional and agricultural policies, these initiatives can become more effective and sustainable.

Livestock-Oriented Programs

Livestock-oriented programs play a crucial role in combating malnutrition and enhancing livelihoods, especially in rural areas. Owning livestock provides households with a reliable source of high-quality protein and bioavailable micronutrients, which are vital for the health of all family members, particularly children. For instance, milk, a common product from livestock, is rich in proteins, minerals, and insulin-like growth factor-I, all of which are important for promoting healthy growth in young children (Mølgaard *et al.*, 2011). In addition to their nutritional value, livestock also serve as productive assets, offering opportunities for income generation through the sale of products like milk, eggs, and meat. While these programs are often designed to improve economic conditions, they also contribute to better nutrition by increasing the availability of animal-source foods, which are rich in essential nutrients like protein, iron, and zinc—nutrients frequently lacking in the diets of rural populations that rely heavily on plant-based foods. Livestock-oriented initiatives, therefore, can significantly help alleviate nutrient deficiencies and enhance overall health outcomes. Research has shown that such programs positively impact both household income and food security, particularly by improving access to animal-source foods.

However, the nutritional benefits of livestock ownership can be limited if the increased household income is not used to purchase nutrient-rich foods. This underscores the importance of integrating nutrition education into livestock-oriented programs to encourage the consumption of these animal-source foods. Nutrition education can help guide households in making healthier food choices, ensuring that the financial benefits of livestock ownership translate into improved nutrition. It is also important to acknowledge potential health risks associated with livestock ownership, such as exposure to animal waste. Improper handling and poor hygiene practices can lead to health issues, particularly for children. These risks must be carefully managed to ensure that livestock ownership does not inadvertently pose a health threat to family members. Promoting responsible livestock management practices and good hygiene standards is essential for mitigating these risks, while still maximizing the nutritional and economic benefits of livestock ownership.

Food Fortification

Food fortification is a key nutritional strategy designed to improve public health by enhancing the nutrient content of commonly consumed foods. This approach involves adding essential nutrients to food products to prevent or correct nutritional deficiencies, particularly among populations at risk of micronutrient deficiencies. Fortification is a cost-effective, scalable strategy that can reach large segments of the population, including economically disadvantaged groups. It has proven particularly effective in addressing deficiencies of micronutrients such as vitamins A and D, various B vitamins, and essential minerals like iron and zinc (Rao and Nair, 2016). In India, food fortification plays a critical role in addressing public health challenges related to malnutrition, with programs focusing on fortifying staple foods that are widely consumed. The success of food fortification depends on selecting the right food vehicles—products that are commonly consumed to ensure broad coverage across different population groups. It is also important that the added nutrients are bioavailable and remain stable throughout storage and cooking.

One of the most successful examples of food fortification in India has been the iodization of salt, a nationwide initiative aimed



at combating iodine deficiency disorders (IDD). Iodine deficiency can lead to serious health problems, including goitre and cognitive impairments, making iodized salt a vital public health intervention. The introduction of iodized salt has significantly reduced the prevalence of IDD in India, benefiting both urban and rural populations (WHO/FAO, 2006). This effort has been extended with the development of double-fortified salt, which combines iodine and iron, though its use is still limited. Another important fortification program in India is the mandatory addition of vitamins A and D to edible oils. These fat-soluble vitamins are essential for healthy vision, immune function, and bone health. Given the widespread prevalence of vitamin A deficiency, especially in children, fortifying cooking oil with vitamin A has been a crucial step in addressing this gap. Additionally, wheat flour fortification with iron and folic acid is a common strategy in several countries, including India, to combat iron deficiency anemia and folate deficiency, both of which are prevalent in many regions. This fortification is particularly important for women and children, who are at higher risk for these deficiencies. India follows the WHO and FAO guidelines for wheat flour fortification, ensuring that these nutrients reach a broad segment of the population (WHO/FAO, 2006).

Despite the widespread availability of fortified foods, their higher cost can limit accessibility for consumers in developing countries, reducing their overall impact on nutrition. The effectiveness of fortification programs also depends on ensuring that the target nutrients are efficiently absorbed by the body and remain stable during food storage and preparation. Furthermore, it is important to consider the potential risks of overconsumption or toxicity from excessive intake of certain nutrients, particularly fat-soluble vitamins like A and D, which can accumulate in the body over time. Given these limitations, especially in low-income regions, biofortification has emerged as a complementary strategy for addressing micronutrient deficiencies and combating hidden hunger.

Biofortification

Biofortification is a scientifically-based strategy designed to combat malnutrition, particularly micronutrient deficiencies, by genetically enhancing the nutritional content of crops. In many developing countries, malnutrition is a persistent challenge, often referred to as “hidden hunger,” where diets lack essential vitamins and minerals (Bouis, 2018). This issue affects over two billion people worldwide, leading to serious health consequences such as stunted growth, weakened immune systems, and reduced economic productivity. Biofortification provides a sustainable and cost-effective solution by improving the nutrient profile of staple crops—such as rice, wheat, maize, and millet—through selective breeding or genetic engineering. This process ensures that vital nutrients are naturally incorporated into crops without altering traditional diets (Jha & Warkentin, 2020). Unlike conventional food fortification, which adds nutrients during post-harvest processing, biofortification increases nutrient content during the growth of the crop, making it a long-term and sustainable approach (Ofori *et al.*, 2022).

In India, biofortification has achieved notable success, spearheaded by the Indian Council of Agricultural Research (ICAR) and its partner institutions. For instance, biofortified rice varieties like *Pusa Samba 1850* are enriched with zinc (26 ppm), offering high yields that benefit regions with zinc deficiencies. Similarly, varieties like *CR Dhan 315* (24.9 ppm of zinc) provide both nutritional and economic advantages for farmers. Other rice varieties, such as *CR Dhan 310*, are enriched with protein (10.3%) and zinc (22.6 ppm), further improving dietary quality. Wheat varieties, including *HD 3298* (43.1 ppm of iron and 12.1% protein), help combat anemia, while *DBW 332*, with 40.6 ppm of zinc, addresses zinc deficiencies in wheat-dependent areas. Additionally, *Pusa Tejas*, a durum wheat variety, combines high protein (12%) with enhanced iron and zinc content, making it suitable for various uses such as bread and pasta.

Biofortified maize varieties also play an important role in filling nutritional gaps. *Pusa HM 8 Improved*, for example, has a balanced profile of lysine (4.18%) and tryptophan (1.06%), key amino acids essential for growth and immunity. Its quick maturation allows it to be cultivated in a variety of agro-climatic zones. The *Pusa Vivek QPM 9 Improved* variety, which is rich in lysine, tryptophan, and provitamin A (8.15 ppm), helps address vitamin A deficiency, a leading cause of night blindness. Similarly, biofortified millets, such as *ICMH 1301* (90 ppm iron and 48 ppm zinc) and hybrids like *HHB 299*, are important for improving micronutrient intake among vulnerable populations. Other crops, including vegetables, pulses, and oilseeds, have also benefited from biofortification. For example, *Pusa Swarnim Mustard*, low in erucic acid and glucosinolates, supports heart health while maintaining high yields. Biofortified cauliflower varieties like *Pusa Betakesari* and *Pusa Hybrid 1* provide provitamin A, enhancing vitamin intake, while pulses like *IPL 220* lentils (iron: 73 ppm, zinc: 51 ppm) and biofortified soybeans such as *NRC-127* help improve protein absorption and fill nutritional gaps.

Root crops, such as sweet potatoes, have also been biofortified. Varieties like *Bhu Sona*, rich in β -carotene (14 mg/100g), and *Bhu Krishna*, which is high in anthocyanins (90 mg/100g), address vitamin A deficiency, a leading cause of blindness and



increased vulnerability to diseases. Biofortified fruits, such as the *Solapur Lal* pomegranate, contain elevated levels of iron (5.6–6.1 mg/100g), zinc (0.64–0.69 mg/100g), and vitamin C (19.4–19.8 mg/100g), providing a dual benefit by addressing micronutrient deficiencies and promoting dietary diversity (Yadava et al., 2018).

In addition to improving health outcomes, biofortified crops offer significant socio-economic benefits. By lowering healthcare costs, boosting productivity, and supporting national development goals, biofortification can have a transformative impact on communities. For example, introducing biofortified pearl millet into school meal programs in Maharashtra has led to noticeable improvements in children's iron status (Finkelstein et al., 2015). Similarly, the inclusion of orange-fleshed sweet potatoes in South African diets helped improve vitamin A levels among schoolchildren, demonstrating biofortification's global potential. However, the widespread adoption of biofortified crops faces several challenges, including limited awareness, misconceptions about yield potential, and distribution obstacles. Farmers may be reluctant to adopt biofortified varieties due to concerns about market acceptance and productivity.

To address these challenges, it is essential to implement educational campaigns, policy initiatives such as subsidized seeds, premium pricing, and the integration of biofortified crops into government programs like the Mid-Day Meal Scheme. Strengthening seed production systems and ensuring genetic purity through initiatives like the Seed Village Program will further support the scalability and sustainability of biofortification (Yadava et al., 2018). Ongoing research is crucial to biofortification's success, particularly in enhancing traits like low-phytic acid content, which improves mineral bioavailability. Advances in genomics-assisted breeding and transgenic technologies are accelerating the development of multi-nutrient-rich cultivars. For instance, maize varieties combining high lysine, tryptophan, provitamin A, and vitamin E are being developed as comprehensive nutritional solutions. Collaboration between breeders, biotechnologists, and public health experts is vital to optimize crop traits and ensure their effective deployment. Biofortification aligns with global objectives like the Sustainable Development Goals (SDGs), especially SDG 2 (Zero Hunger) and SDG 3 (Good Health and Well-being). The vision of pioneers like Prof. M.S. Swaminathan, who emphasized the integration of agriculture, health, and nutrition, is increasingly relevant in the fight against malnutrition. By prioritizing biofortified crops, countries can make significant progress in eradicating malnutrition and promoting healthier, more resilient populations.

Challenges and Solutions of Nutritionally Sensitive Agricultural Strategies

The shift toward nutritionally sensitive agricultural strategies presents a range of challenges, requiring comprehensive solutions that address both structural and behavioral barriers. While agricultural income is a key factor in driving change, it is not enough by itself to ensure dietary diversification without concurrent community education on the importance of balanced diets. Traditional practices that prioritize calorie-dense staples like rice and wheat continue to dominate, leaving issues like hidden hunger unresolved. Farmers often focus on these crops for their economic value, overlooking nutrient-dense alternatives such as pulses, millets, and vegetables. To address this, it is crucial to provide farmers with education and training that emphasizes the benefits of dietary diversification and the potential economic returns from cultivating a broader variety of crops.

Another significant challenge is the lack of nutritional awareness within communities. Many households may not fully understand the value of a balanced diet or the nutritional benefits of animal-source foods, leading to underutilization of available resources. Community-based nutrition education, including workshops, demonstrations, and outreach initiatives, can help bridge this knowledge gap and encourage healthier dietary practices. Economic limitations also pose an obstacle to adopting nutrient-sensitive agriculture. Even with higher agricultural or livestock income, households may prioritize immediate financial needs over investing in nutrient-rich foods. Financial solutions like microcredit schemes and financial literacy programs can empower households to make informed decisions, enabling them to better allocate resources toward improved nutrition and health.

Access to essential resources is another key barrier. Smallholder farmers often face difficulties in obtaining quality seeds, animal feed, veterinary services, and access to markets. Establishing cooperatives can facilitate resource-sharing, improving both productivity and market access. Additionally, strengthening infrastructure for storage and transportation can ensure that nutrient-rich foods reach consumers more efficiently. Cultural beliefs and traditional practices also play a significant role in shaping dietary choices. In some communities, certain foods—particularly animal-source products—are undervalued or avoided due to cultural norms. Engaging local leaders and fostering respectful community dialogue can help shift attitudes and promote the inclusion of a wider range of foods in people's diets. Health risks related to livestock ownership, such as zoonotic diseases and poor waste management, must also be addressed. Education on hygiene practices and proper waste disposal can



help mitigate these risks, ensuring safer and more sustainable livestock management. Moreover, integrating nutrition-sensitive agriculture with national programs, such as India's initiatives on fortified foods and biofortified crops, can provide a systemic approach to improving nutritional outcomes. By tackling these challenges through a combination of education, infrastructure development, economic support, and cultural engagement, we can establish a robust framework for nutrient-sensitive agriculture. Such an approach not only strengthens food security but also improves public health, empowering communities to make informed dietary choices while promoting sustainable agricultural practices.

Future prospects

Nutrient-sensitive agriculture (NSA) has significant potential to tackle the growing issue of malnutrition while promoting sustainable agricultural practices. The future of NSA lies in combining agricultural innovation with nutritional objectives, creating systems that not only provide food but also enhance the quality of diets. This approach focuses on cultivating crops with improved nutritional profiles, utilizing biofortification techniques to boost essential micronutrients like iron, zinc, and vitamin A in staple crops. The development and widespread use of biofortified varieties, such as high-zinc wheat, iron-rich pearl millet, and vitamin A-enriched sweet potato, demonstrate how NSA can effectively combat hidden hunger.

To strengthen NSA, a multifaceted strategy is needed, including research into developing multi-nutrient-rich crops, improving seed systems for better distribution, and creating supportive policy frameworks. Modern breeding technologies, such as genomics and transgenics, can accelerate the development of nutrient-dense crops and address challenges like the low bioavailability of micronutrients. Furthermore, NSA must incorporate sustainable agricultural practices, including crop diversification, soil health management, and water-efficient farming, to build resilience against climate change and environmental degradation.

Public awareness campaigns and farmer education are crucial for bridging the gap between agricultural innovations and their practical application. Incentives, such as minimum support prices for biofortified crops and their inclusion in government nutrition programs like school meal initiatives, can help drive adoption. International collaboration and increased investment in research, along with strong public-private partnerships, will further enhance the impact of NSA. By aligning agricultural production with nutritional goals, NSA offers the potential for a transformative shift in addressing malnutrition. It ensures that food systems prioritize not only quantity but also quality, fostering healthier populations while maintaining ecological sustainability. As nutrient-sensitive agriculture continues to evolve, it will play a key role in achieving global nutrition and sustainability targets, shaping a future where agriculture is central to both health and well-being.

Conclusion

Shifting toward nutritionally sensitive agriculture is crucial for addressing the interconnected challenges of food security and malnutrition. Traditional agricultural practices, which often focus primarily on staple crops, frequently overlook the importance of dietary diversity, contributing to hidden hunger even when caloric intake is adequate. Adopting nutrient-sensitive strategies such as food fortification, biofortification, homestead gardening, livestock-based programs, and dietary diversification can significantly improve household food security and provide better access to essential micronutrients. Initiatives like iodine-enriched salt and vitamin-fortified oils have played a key role in addressing widespread deficiencies in India and other developing countries. Biofortification further supports these efforts by developing crops like iron-rich pearl millet, which reach communities with limited access to fortified foods. However, these interventions must be paired with strong nutrition education to overcome cultural barriers, traditional farming practices, and economic challenges that hinder their uptake. By integrating the agriculture, health, and nutrition sectors, we can create a cohesive framework that enhances agricultural productivity while promoting public health. Collaborative efforts should not only focus on producing nutrient-dense foods but also on raising awareness about their importance for balanced diets. This holistic approach empowers households to make informed decisions, helping to reduce malnutrition and promote sustainable agricultural practices. Ultimately, such efforts contribute to building healthier, more resilient populations globally.

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MOLECULAR INSIGHTS INTO THE DIVERSITY AND FUNCTION OF INSECT POLLINATORS

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About 85% of flowering plants are pollinated by insect pollinators. A greater diversity of insect pollinators increases the chances of successful pollination and ensures high agricultural productivity, food security and enriched biodiversity. Molecular studies of insects are becoming increasingly significant because they can provide greater insights into insect biology, behaviour, evolution, and ecological roles which help in understanding plant pollinator mutualistic relationship and devise strategies for protection and conservation. The amalgamation of taxonomic tools with genetic data enables accurate identification of cryptic or closely related species with morphological similarities. Molecular taxonomy provides valuable tools for resolving taxonomic challenges and discovering new species among insect pollinators. Such research is essential for enhancing the accuracy and significance of taxonomic studies and contributes to identifying and categorizing endemic insect pollinator species within the country. The mitochondrial genome is widely used in molecular studies of insect pollinators.

In the animal kingdom, insects comprise the maximum species composition. They possess a huge amount of undiscovered genetic diversity and gene pool that can be discovered by molecular marker techniques (Yogesh and Khan, 2014). In insects, DNA markers are very significant tools for the estimation of genetic diversity and gene flow between species (Speight *et al.*, 2005).

Molecular characterization have unlocked a wide range of new approaches to insects in the area of molecular phylogenetic and taxonomic studies. It helps in the study of genetic diversity, genetic relatedness and phylogenetic analysis of the various populations at species level. Molecular characterization includes species level genetic diversity research, genetic relationship and phylogenetic analysis. Genetic diversity is very essential for pollinators to adapt in the changing environmental conditions (Fisher, 1930; Lynch and Walsh, 1998). Genetic variation shapes and defines individuals, populations, subspecies, species and ultimately the kingdoms of life on earth. The presence of diverse alleles in the gene pool and thus distinct genotypes within populations causes genetic variety among individuals. Genetic

diversity should be distinguished from genetic variability, which defines the tendency of genetic traits to fluctuate within populations (Laikre *et al.*, 2010). Information about genetic diversity is essential for the development of suitable strategies in conservation biology as well as in many other applied fields. Analysis of molecular phylogenetics and genetic diversity can help to simplify the taxonomic identity and evolutionary relationships of the wild species. These methods can also aid in the prevention of misidentification and the helpful in planning of successful germplasm management strategies. Variability and genetic diversity are essential aspects in evolution and applied sciences because they are very essential to know the response of an organism to things like environmental stress, natural selection and disease susceptibility. Mitochondrial DNA (mtDNA) is one of the most commonly used molecules in systematic, species characterization, population structure and phylogenetic studies. Mitochondrial genome is very useful for revealing evolutionary history because mtDNA is maternally inherited and it evolve rapidly as compared to the nuclear DNA. High mutation rate of mtDNA makes it most useful for comparisons of individuals within species and for comparisons of species that are closely or moderately-closely related, among which the number of sequence differences can be easily counted (Jalali *et al.*, 2015). In the last two decades, the insect mitochondrial genome has been the most widely used molecular marker for population genetics, phylogeography and molecular diagnostics due to its relative simplicity of amplification and sequencing. Molecular studies on insect pollinators are carried out to a limited extent in most of countries like India, Thailand, Philippines, Korea and China.

MtDNA study is extremely useful for the study of populations, hybridization, subspecies and species and many investigators has worked on the mtDNA characterization of insects i.e. Moritz *et al.* (1986); Smith (1988); Sambook *et al.* (1989); Arias *et al.* (1990); Smith and Brown (1990); Cornuet *et al.* (1991); Smith (1991, 1993); Hall and Smith (1991); Sheppard and Mcpherson (1991); Smith *et al.* (1991); Sheppard *et al.* (1991a); Sheppard *et al.* (1991b) ; Sheppard *et al.* (1991); Smith *et al.* (1991); Garnery *et al.* (1991), Garnery *et al.* (1992); Willis *et al.* (1992); Crozier and Crozier (1993); Lobo (1995); Arias and Sheppard (1996); Arias *et al.* (1996); Sheppard *et al.* (1996); Meixner *et al.* (2000); Funk and Omland (2003); Hebert *et al.* (2003a, 2003b); Hebert *et al.* (2004); Weinlich *et al.* (2004), Songram *et al.* (2005); Armstrong and Ball (2005); Ball *et al.* (2005); Janzen *et al.* (2005); Shufan and Puterka (2011) and Virgilio *et al.* (2012).

Animal mitochondrial genomes are potential models for molecular evolution and markers for phylogenetic and population studies. DNA markers have made a significant contribution to molecular studies of insects (Behura, 2006). Mitochondrial



DNA studies on the *Apis* species has been started early, with the study of *Apis mellifera* (Moritz and Hawkins, 1985; Moritz *et al.* 1986; Smith and Brown, 1988). Some of the earlier studies focus on Africanised bees in the North and South America (Smith and Brown, 1988; Hall and Muralidharan, 1989; Smith *et al.*, 1989; Arias and Nobrega, 1991; Crozier *et al.*, 1991; Hall and Smith, 1991; Rinderer, *et al.*, 1991 and Smith, 1991a, b) and others studies the variation among the European and African populations and subspecies of *A. mellifera* (Smith, 1988; Smith and Brown, 1990; Cornuet and Garnery, 1991; Garnery *et al.*, 1991, 1992; Smith *et al.*, 1991, 1997; Arias and Sheppard, 1996, 2005; Sheppard *et al.*, 1996; de la Rua *et al.*, 1998, 2001a, b, 2004, 2005, 2006; Meixner *et al.*, 2000; Canovas *et al.*, 2008; Munoz *et al.*, 2009 and Shaibi *et al.*, 2009). These studies continue to the present day (e.g. Sheppard and Smith, 2000; Pinto *et al.*, 2003, 2004, 2005; Schneider *et al.*, 2004 and Smith, 2011). Vawter and Brown (1986) observed that the rate of evolution of vertebrate mitochondrial DNA is rapid, compared to the rate for vertebrate nuclear DNA and play important role in its widespread use for evolutionary studies. They observed that the mitochondrial and nuclear DNA's of sea urchins evolve at approximately the same rate, but in case of vertebrates, the mitochondrial DNA rate is five to ten times faster than the nuclear DNA rate.

Zayed (2009) has worked on bee genetics and conservation biology to understand the causes of pollinators decline. It helped to the conservation of diploid animals and proven to be important for both overcoming genetic threats to population viability. The application of genetics helps in providing tools to guide and develop appropriate conservation strategies. They found that bees are very prone to extinction. So, genetics provide invaluable tools for managing bee populations to circumvent pollinator decline.

Cho *et al.* (2013) has developed a DNA standardized identification dataset of insect pest that can be distinguished in food. They additionally tried the efficacy of these DNA barcode sequences for recognizing food-related insect pests. A 658 bp piece of the mitochondrial cytochrome c oxidase subunit I (COI) quality was examined from 55 types of food-related insects pest in Korea. The outcomes demonstrated that this segment of the COI quality viably segregated > 90% of the food-related insect pests.

Mandal *et al.* (2014) summarized some studies on the identification and phylogenetic studies of insects on the application of various mitochondrial molecular markers. They analyzed that mitochondrial based markers have been extensively used as molecular markers for phylogenetic studies. For phylogenetic studies and identification, various markers have been used viz., markers for 16S r RNA, 12S r RNA, ND (1-6 genes), ATPase and control regions. Jalali *et al.* (2015) identified some agriculturally important insect pests by DNA barcoding method. They collected specimens across different ecosystem of India and morphologically identified them upto species level. DNA barcoding method was used for this purpose and this study provides basic knowledge to molecular ecology of important insect pests attacking horticultural crops in South India.

Singh *et al.* (2016) has studied the molecular techniques include restriction fragment length polymorphism (RFLP), random amplified polymorphic DNA (RAPD) and Amplified fragment length polymorphism (AFLP) etc. to characterize the butterflies at molecular level. RAPD markers is well suited for the study of genetic variation between closely related species of insects. The traditional method of identification of butterflies is very time consuming and not considered as effective. They concluded that molecular techniques provide a very useful way to assess the genetic diversity and facilitate genotyping, classification, inventorying and phylogenetic studies.

BRUCELLOSIS IN INDIA : A COMPREHENSIVE REVIEW OF EPIDEMIOLOGICAL TRENDS, DIAGNOSTIC APPROACHES AND PREVENTIVE MEASURES

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Abstract

Brucellosis is an economically important zoonotic bacterial disease caused by the genus *Brucella*. This genus includes species such as *B. abortus*, *B. melitensis*, *B. suis*, *B. ovis*, *B. canis*, *B. neotomae*, and *B. microti*, which affect terrestrial animals, and *B. ceti* and *B. pinnipedialis*, which affect marine mammals. The first three species are known as the classical *Brucella*, with differentiation into biovars. *Brucella* lacks classic virulence genes that encode capsules, plasmids, pili, or exotoxins, yet it persists in the host and multiplies within phagocytic cells. Brucellosis occurs worldwide, except in a few countries where it has been successfully eradicated. Aborted foetuses, foetal membranes, and uterine discharges are considered major sources of infection. Transmission to animals occurs primarily through ingestion of contaminated feed and water, contact with infected aborted foetuses, foetal membranes, or genital discharges, and artificial insemination using semen from infected bulls. The bacteria preferentially localize in the reproductive tracts of pregnant animals, causing late-term abortion, retained foetal membranes, and infertility. In males, the disease manifests as orchitis and epididymitis. Serological tests such as the Rose Bengal Plate Test (RBPT) for screening and the Complement Fixation Test (CFT) for confirmation are routinely used. Brucellosis remains one of the most common zoonotic diseases globally. Humans contract the disease mainly by consuming unpasteurized dairy products or through direct contact with infected animal tissues. The disease results in significant economic losses due to abortions, the culling of infected animals, disruption of animal export trade, treatment costs, and expenses associated with research and eradication programs. Formulating effective control strategies is essential to manage brucellosis. These strategies should include surveillance to identify infected animals, prevention of transmission to non-infected animals, and removal of reservoirs to eliminate sources of infection. Additionally, vaccinating susceptible animals is crucial in areas with high brucellosis prevalence.

Key words : *Brucellosis, Zoonoses, Surveillance, Prevalence*

Introduction

Brucellosis, also known as contagious abortion or Bang's disease, is a bacterial infection that affects livestock and wildlife. It is caused by species within the *Brucella* genus and is a zoonotic disease with serious implications for animal health, public health, and international trade. The disease leads to significant economic losses in livestock due to reproductive failures, such as abortion, infertility, and reduced milk production. In humans, brucellosis poses a public health threat and is often transmitted through unpasteurized dairy products or direct contact with infected animals. It can cause a variety of symptoms, including fever and joint pain, and if left untreated, may result in chronic conditions.

Etiology :

Brucellosis is a zoonotic disease caused by facultative intracellular bacteria of the genus *Brucella*. These bacteria have the ability to survive and multiply within the phagocytic cells of the host, which is a crucial factor in their pathogenesis. They are capable of being sequestered within monocytes and macrophages of the mononuclear phagocytic system (MPS), including organs like the lymph nodes, liver, spleen, and bone marrow. The genus *Brucella* is currently classified into 12 recognized species based on differences in pathogenicity and host preferences:

These species include:

- (a) *Brucella melitensis*: Primarily infects goats and sheep?
- (b) *Brucella abortus*: Affects cattle and bison?
- (c) *Brucella suis*: Found in swine, hares, rodents, and reindeer.
- (d) *Brucella ovis*: Specific to sheep.



- (e) *Brucella canis*: Infects dogs?.
- (f) *Brucella neotomae*: Associated with desert wood rats.
- (g) *Brucella ceti*: Infects cetaceans (whales and dolphins)?.
- (h) *Brucella pinnipedialis*: Found in pinnipeds (seals and sea lions)?

The more recently identified species are:

- (a) *Brucella microti*: Isolated from the common vole?.
- (b) *Brucella inopinata*: Linked to a human breast implant infection?.
- (c) *Brucella papionis*: Found in baboons?.
- (d) *Brucella vulpis*: Detected in red foxes?.

This classification reflects improved understanding of the genus, with contributions from various studies and researchers, including Corbel (1997), Scholz *et al.* (2008, 2010, 2016), and Whatmore *et al.* (2014). These advancements highlight the broad host range and ecological diversity of *Brucella*.

Epidemiology:

(a) Geographical distribution: The global distribution of brucellosis is highly dynamic, characterized by the emergence of new infection areas and the re-emergence of the disease in regions where it previously existed. Human brucellosis has seen increasing prevalence in Central Asia and the Middle East in recent years (Pappas *et al.*, 2006). The disease remains prevalent in several regions, including Mediterranean Europe, Central and South America, Mexico, Africa, India, and Italy, while being effectively controlled or eradicated in countries like Canada, Australia, Cyprus, Norway, Finland, the Netherlands, Denmark, Sweden, New Zealand, and the United Kingdom (CDC, 2018). A 19-year report (1996–2014) by the World Organization for Animal Health (OIE) classified countries into three categories:

Enzootic for brucellosis : Countries with active infections or free for less than three years.

Non-enzootic : Countries free from brucellosis for at least three years but still at risk.

Free of brucellosis : Nations consistently devoid of the disease throughout the study period. Disease-free regions are primarily in Europe and Oceania, while high-prevalence areas are found in Africa, Asia, and South America (Cárdenas *et al.*, 2019).

Brucellosis is endemic in regions like Western Asia, India, the Middle East, Southern Europe, and South America (Mantur & Amarnath, 2008; Franc *et al.*, 2018). In Iran, *B. abortus* biovar 3 is the dominant strain (Dadar *et al.*, 2019). In Africa, South America, Pakistan, and Egypt, water buffaloes are primarily affected by *B. abortus* biovar 1 (Megid *et al.*, 2005; Wareth *et al.*, 2014). Notably, *B. melitensis* infection in cattle is an increasing concern in Kuwait, Saudi Arabia, Israel, and parts of Southern Europe (Yilma *et al.*, 2016). The epidemiology of brucellosis remains unpredictable due to the emergence of new strains and adaptations of existing strains to novel hosts and environmental conditions. In endemic areas, sporadic cases in children have also been documented, highlighting the disease's complex dynamics (Mantur *et al.*, 2004).

(b) Host range and *Brucella* diversity: The main strain that infects cattle is *B. abortus*. Cattle can also be transiently infected by *B. suis* and, more commonly, by *B. melitensis* when they share pasture or facilities with infected pigs, goats, and sheep. *B. melitensis* and *B. suis* can be transmitted through cow's milk, posing a serious public health threat (Acha and Szyfres, 2003). The primary cause of brucellosis in goats is *B. melitensis*. However, in certain countries like Brazil, where *B. melitensis* is absent, goats can become infected with *B. abortus* (Lilenbaum *et al.*, 2007). Camels can be infected by *B. abortus* and *B. melitensis* when they are pastured with infected sheep, goats, and cattle. Milk from infected camels is a major source of infection, particularly underestimated in the Middle East (Musa *et al.*, 2008).

The main etiologic agent for dog brucellosis is *B. canis*, although sporadic cases caused by *B. abortus*, *B. suis*, and *B. melitensis* have been reported (Acha and Szyfres, 2003).

Transmission:

Brucella can be transmitted through horizontal or vertical routes (Meltzer *et al.*, 2010). Pregnant animals harbor *Brucella*



organisms in high concentrations within the uterus, making aborted fetuses, placental membranes, and uterine discharges the primary sources of infection. Organisms shed in the milk of infected animals can also transmit the infection to newborns. In favorable conditions, such as cold and moist environments, *Brucella* can survive in the environment for several months (Godfroid *et al.*, 2011). Animals typically contract the infection through the ingestion of contaminated feed or water or by coming into contact with aborted fetuses, fetal membranes, or uterine discharges. Inhalation is another possible route of transmission, particularly in confined environments. Infected bulls may spread *Brucella* to cows through natural mating or artificial insemination, thereby introducing the infection into new herds (Acha and Szyfres, 2001). Tukana and Gummow (2017) highlighted that sharing common water sources with *Brucella*-positive animals is a significant factor in the spread of the disease. Similarly, McDermott *et al.* (2013) emphasized that poor hygiene and inadequate management practices exacerbate the transmission risk in communal grazing systems.

Clinical signs:

Various clinical signs are observed in animals infected with *Brucella*, with reproductive failure being the hallmark manifestation of *B. abortus* infections. This often includes abortions and the birth of weak offspring, which may act as carriers within the herd. The primary clinical signs and complications in brucellosis are closely associated with the reproductive tract. The incubation period can range from two weeks to several months (Smith *et al.*, 2020). While calves may acquire the infection early, they generally remain asymptomatic until they reach reproductive maturity. In pregnant animals, brucellosis typically presents as late-term abortions, weak or stillborn calves, reduced fertility, retained fetal membranes, endometritis, and decreased milk production (Johnson & Adams, 2019; Jones *et al.*, 2021). In susceptible herds, abortion rates may vary significantly, ranging from 30% to 80% (Johnson & Adams, 2019). Calves born at full term may die shortly after birth. Newborns and aborted fetuses may show lesions such as fibrinous pleuritis and interstitial pneumonia (Carvalho Neta *et al.*, 2010). In male animals, clinical signs include orchitis and epididymitis. Chronic infections can lead to hygroma and conditions such as cervical bursitis (Macedo *et al.*, 2019). In the seminal vesicles, acute inflammation transitions into a chronic phase, characterized by fibrinoid induration and areas of dry necrosis encapsulated by fibrous tissue. In some cases, testicular atrophy occurs, leaving testicles smaller than normal. Advanced cases may involve the formation of fluctuating lesions filled with thin purulent exudate (Brown *et al.*, 2018).

Diagnosis:

Epidemiological patterns and historical data play a crucial role in the clinical diagnosis of brucellosis. The World Health Organization (WHO) estimates millions of brucellosis cases globally each year, although the actual incidence may be 10-25 times higher due to underreporting and inadequate diagnostic guidelines (Singh *et al.*, 2021). One significant challenge is the absence of standardized diagnostic protocols, particularly in endemic regions. Studies have highlighted the serological diversity of the disease. Following acute brucellosis, the primary immune response is characterized by IgM antibodies, while secondary responses involve IgG antibodies, which gradually decline over time. Researchers have identified seven clinical subtypes of brucellosis based on this variable immune response, reflecting the complex epidemiological dynamics of the disease (Avijgan *et al.*, 2019).

Diagnostic Approaches:

Timely and accurate diagnosis is critical for effective therapeutic management and control measures. Diagnosis involves bacterial culture, serological testing, and molecular methods that also support herd screening, epidemiological surveillance, and eradication programs.

1. Bacteriological Techniques:

Isolation and identification of *Brucella* spp. remain the gold standard for diagnosis.

Cultures from clinical samples such as blood, milk, or fetal membranes are highly specific but require stringent biosafety protocols due to zoonotic risks (Rahman *et al.*, 2020).

2. Serological Tests:

Rose Bengal Plate Test (RBPT): A widely used screening tool with high sensitivity but prone to false positives in animals with cross-reacting bacterial infections.

Complement Fixation Test (CFT): A confirmatory test with good specificity, often used alongside RBPT for reliable results (Dos Santos *et al.*, 2017).



➤ **ELISA:**

Both competitive and indirect ELISA are valuable for detecting antibodies.

Recent advancements include the use of *B. melitensis* B115-based ELISA, which helps reduce false positives due to cross-reactivity with other bacteria (Trotta *et al.*, 2020).

➤ **Fluorescence Polarization Assay (FPA):** A rapid diagnostic tool increasingly used for post-vaccinal antibody detection (Kalleshmurthy *et al.*, 2020).

3. Molecular Diagnostics:

➤ **Polymerase Chain Reaction (PCR):** Offers high sensitivity and specificity but struggles to differentiate between vaccine and field strains of *Brucella* spp.

➤ **Real-Time PCR (qPCR):**

A novel method targeting the outer membrane protein of *B. abortus* has successfully distinguished the virulent strain from the S19 vaccine strain, minimizing false positives (Kaynak-Onurdag *et al.*, 2016).

4. Emerging Biomarkers:

➤ MicroRNAs (miRNAs) are gaining attention as potential biomarkers for the early detection of brucellosis, offering opportunities for precise and non-invasive diagnostics (Chen *et al.*, 2021).

5. Advanced Techniques:

➤ Intradermal tests like Burnet's test can assess hypersensitivity in infected animals. However, their specificity may vary.

➤ Proteomic studies are identifying novel antigenic targets for improved serological testing and vaccine development (Patel *et al.*, 2022).

Treatment:

Brucellosis is notoriously difficult to treat due to the intracellular survival of *Brucella* species, which reside within macrophages, complicating the efficacy of conventional antibiotic therapy (Farid *et al.*, 1961; Seleem *et al.*, 2008). Both human and animal treatment regimens frequently face challenges, including low success rates and the risk of relapse. In humans, treatment with single antibiotics like ciprofloxacin or ceftriaxone has shown limited success (Dođanay and Aygen, 1992; Lang *et al.*, 1992). Combination therapy is commonly preferred to minimize the chance of relapse and to enhance the treatment's effectiveness. The use of a combination of drugs helps reduce the development of resistance, an important consideration in managing chronic infections (Villate and Casallas, 2020). For uncomplicated brucellosis in humans (without complications such as endocarditis or neuro brucellosis), a multi-drug regimen is recommended. A standard regimen involves doxycycline (100 mg twice daily) along with rifampin (600-900 mg/day) for 6 weeks. In some cases, amikacin can be included in the regimen for its synergistic effects (Villate and Casallas, 2020). In vitro studies have explored various drugs for their efficacy against *Brucella* spp. Pefloxacin, lomefloxacin, meropenem, and azithromycin were tested, with azithromycin showing the highest activity, followed by meropenem (Maletskaia, 2002). Additionally, the combination of doxycycline and rifampin for six weeks, or doxycycline combined with streptomycin for a shorter duration (2-3 weeks), is also frequently recommended (Colmenero *et al.*, 1994; Ariza *et al.*, 2007). Although doxycycline-streptomycin therapy is considered one of the most effective regimens, its practical application is limited by the need for parenteral administration of streptomycin over a three-week period. Alternatively, the combination of doxycycline and gentamicin, with gentamicin administered parenterally for just one week, has also been shown to be effective (Glynn and Lynn, 2008). Comparative studies between doxycycline-rifampin and doxycycline-co-trimoxazole for human brucellosis treatment have revealed that the risk of relapse is higher with the rifampin-co-trimoxazole combination, which may suggest a higher therapeutic advantage when combining doxycycline with co-trimoxazole (Roushan *et al.*, 2004). Further research has also highlighted non-antibiotic compounds, such as tauroursodeoxycholic acid and ginseng saponin fraction A, as potential adjuvants to inhibit intracellular replication of *Brucella* (G³owacka *et al.*, 2018). Despite advances in pharmacotherapy, fluoroquinolones have shown limited efficacy in brucellosis treatment and are not recommended as first-line therapy (Pappas *et al.*, 2006). Given the complexity of brucellosis, close collaboration between clinicians and microbiologists is essential to ensure proper diagnosis, effective treatment, and monitoring to reduce the risk of relapse (Mantur *et al.*, 2004; Mantur *et al.*, 2006; Mantur *et al.*, 2007). In bovine brucellosis, particularly within dairy herds, effective management is critical to preventing economic losses. A promising novel approach in



the treatment of bovine brucellosis involves the use of bacteriophage lysates, such as RB51 and S19, which have shown potential in immunotherapy. A combination of these phage lysates, administered subcutaneously, triggered a strong immune response and successfully cleared the infection from the animals. After 3 months of phage cocktail treatment, blood samples tested negative for *Brucella*, indicating the effectiveness of this immunotherapy (Saxena and Raj, 2018). This novel approach may represent an alternative to traditional antibiotics, offering a strategy that reduces the chances of resistance development.

Prevention and Control :

The prevention and control of bovine brucellosis require a multifaceted approach that involves coordinated efforts in veterinary public health, surveillance, vaccination, biosecurity, and management practices. Bovine brucellosis not only impacts herd productivity but also presents significant zoonotic risks to humans. The key components of prevention and control.

Vaccination of susceptible animal hosts and the elimination of infected animals are crucial in managing brucellosis, particularly in endemic areas.

1. Vaccination Strategies:

Vaccination is widely regarded as the most effective measure to control brucellosis in livestock. The most common vaccines used are **Brucella abortus strain 19**, **B. abortus RB51**, and **B. melitensis Rev1**, each serving specific purposes depending on the host species and regional requirements.

➤ **B. abortus S19**: This vaccine has been the cornerstone for controlling bovine brucellosis. It is effective in preventing infection and abortion caused by *B. abortus* but has been associated with interference in serodiagnosis. Despite these limitations, it remains a widely used tool in bovine brucellosis control programs (Sangari *et al.*, 1994; Gheibi *et al.*, 2018).

➤ **B. abortus RB51**: This strain offers a significant advantage over S19 in that it does not interfere with diagnostic tests, making it ideal for use in eradication programs. It provides protection against brucellosis without leading to false-positive diagnostic results (Moriyón *et al.*, 2004).

➤ **B. melitensis Rev1**: This vaccine is the primary choice for small ruminants (goats and sheep) and has been shown to be effective in controlling *B. melitensis* infections. However, it has high virulence and can induce abortions, making its use during pregnancy not recommended. The vaccine also interferes with serological diagnostics (Benkirane *et al.*, 2014; Godfroid *et al.*, 2010).

Development of New Vaccines:

In addition to traditional vaccines, there is a growing need to develop novel and more effective vaccines. **DNA vaccines** and **multivalent fusion vaccines** have shown promise in preclinical and clinical trials, offering the potential for improved protection by targeting multiple strains of *Brucella* and eliciting robust immune responses (Gomez *et al.*, 2017; CDC, 2017).

Recombinant proteins such as *FliC* and *Omp16* have been investigated as components for new vaccines. These proteins have demonstrated strong immune responses in animal models and are considered potential candidates for future vaccine development (Sadeghi *et al.*, 2020; Alizadeh *et al.*, 2019).

Subunit vaccines incorporating proteins like *BP26*, *Omp25*, and *L7/L12* have shown safety but offer less protection than traditional vaccines like S19. However, a combined subunit vaccine using *BP26*, *Omp25*, and *L7/L12* showed enhanced protection compared to individual antigens (Gupta *et al.*, 2019).

2. Surveillance and Monitoring:

Effective surveillance systems are essential for detecting brucellosis outbreaks and monitoring the effectiveness of control programs. Surveillance should include regular serological testing of animals, especially in high-risk areas, to detect brucellosis infections before clinical signs appear. The use of molecular techniques like PCR for identifying *Brucella* DNA has also improved the speed and accuracy of surveillance (Ducrotoy *et al.*, 2018). Additionally, a nationwide surveillance program in countries like South Korea has shown the importance of monitoring both cattle herds and slaughterhouses to track zoonotic transmission (Ryu *et al.*, 2019).

3. Biosecurity and Management Practices:

Implementing strong biosecurity measures is crucial to prevent the introduction and spread of *Brucella* within herds. This includes:



- **Quarantine:** Isolating new animals for a period of time before introducing them to the herd to ensure they are free from brucellosis.
- **Movement control:** Regulating the movement of animals between farms, especially in regions with a high prevalence of brucellosis, to prevent the introduction of infected animals.
- **Culling:** Infected animals, particularly those identified through serological tests, should be culled to prevent further spread of the disease. Culling of Brucella-positive animals is an important component of eradication programs (Zamri-Saad & Kamarudin, 2016).

4. Test-and-Slaughter Policies:

Countries in Southeast Asia often implement “Test-and-Slaughter” policies, where animals undergo routine testing for brucellosis and any positive cases are culled. While this approach is effective in reducing prevalence, it has limitations, such as the inability to detect all infected animals and the logistical challenges of testing and slaughtering large numbers of animals. Additionally, there is a risk of reinfection if biosecurity and movement controls are not strictly enforced (Gwida *et al.*, 2010).

5. Control of Zoonotic Transmission :

Human brucellosis is mainly transmitted through the consumption of unpasteurized dairy products and direct contact with infected animals or animal products. Therefore, public health measures like milk pasteurization, proper disposal of animal remains, and increased awareness in high-risk communities are crucial for preventing zoonotic transmission (Dadar *et al.*, 2019). Educational campaigns targeting farmers, livestock handlers, and consumers about the risks of brucellosis and the importance of hygiene and milk pasteurization are vital for reducing human cases.

6. Semen and Embryo Management:

Introducing semen from certified brucellosis-free herds is a key preventive measure, especially in herds utilizing artificial insemination. Semen from infected bulls can transmit the disease to uninfected herds, understanding the importance of certifying and testing semen (Cardenas *et al.*, 2019).

7. International Collaboration and Trade Regulations:

Brucellosis control transcends national borders. International trade in livestock and animal products poses a significant risk for the spread of brucellosis. Adhering to international trade regulations, such as the OIE guidelines for safe trade and animal transport is crucial. This includes implementing quarantine measures, testing, and certification to ensure imported animals are free of brucellosis (OIE, 2016).

8. Research and Development :

Continued research into new diagnostic tools, vaccines, and treatment strategies is essential for enhancing bovine brucellosis control. Advances in molecular diagnostics, like PCR and ELISA, have provided more accurate detection tools (Ducrottoy *et al.*, 2018). Exploring new vaccine formulations that can better differentiate between vaccinated and naturally infected animals is also underway to improve vaccination programs effectiveness.

Public health importance :

Brucellosis remains a significant public health hazard due to the expansion of animal industries, inadequate hygienic practices in animal husbandry, and poor food handling. These factors contribute to the persistence of brucellosis as a zoonotic disease, posing a risk to humans and animals alike. Additionally, international travel and the importation of dairy products into Brucella-free regions exacerbate the growing concern over human brucellosis, making it a global public health issue. Human brucellosis, a debilitating zoonotic disease, can manifest as acute or chronic illness. While the case fatality rate is low, the disease often becomes subclinical or chronic, particularly when not diagnosed or treated early. The disease can affect all age groups, including congenital cases, with documented instances of transmission from infected mothers to infants (FAO *et al.*, 2006). High-risk groups include occupationally exposed individuals, such as slaughterhouse workers, hunters, farmers, veterinarians, and laboratory personnel, who are more likely to encounter infected animals or animal products (FAO, 2003).

The major Brucella species of concern for zoonotic transmission are :

- *B. abortus* (biovars 1–6), primarily affecting cattle and other bovidae.



- *B. suis* (biovars 1–5), primarily affecting swine.
- *B. melitensis* (biovars 1–3), primarily affecting sheep and goats.

Among these, *B. melitensis* is the most pathogenic to humans and remains the leading cause of human brucellosis worldwide (FAO, 2003; SCAHAW, 2001). The persistent infection of mammary glands and supramammary lymph nodes in infected animals leads to the constant or intermittent shedding of the organisms in milk, which is an important source of human infection, particularly when unpasteurized milk is consumed. In addition to these three primary species, *B. canis* also holds zoonotic significance, as infections in humans caused by this species can resemble brucellosis caused by other *Brucella* species, leading to similar symptoms and complications (CFSPH, 2012). The continued growth of intensive animal farming, coupled with increasing international trade in animals and animal products, raises concerns regarding the global spread of brucellosis, particularly in areas previously considered free of the disease. The introduction of infected animals or contaminated animal products into new regions significantly increases the risk of outbreaks in both humans and animals. These outbreaks can be further exacerbated by insufficient public health infrastructure and inadequate animal health management in affected regions.

Economic importance :

Brucellosis causes significant economic losses in livestock production, with various direct and indirect costs associated with the disease. These losses arise from multiple factors, including:

- Abortion and stillbirths in infected animals, leading to loss of future production.
- Reduced milk production, impacting dairy farms' profitability.
- Culling of infected animals, resulting in loss of valuable breeding stock and increased expenses for replacement animals.
- Disruptions in international animal trade, as brucellosis is a significant barrier to animal exports, particularly in countries with endemic disease.
- Loss of man-hours due to the need for veterinary care, surveillance, and disease control measures.
- Medical costs related to human brucellosis treatment, particularly in high-risk populations.
- Government expenses incurred for research, eradication programs, and supporting the agricultural industry during outbreaks (Georgios *et al.*, 2005).

Despite the high costs of brucellosis management and eradication programs, the long-term benefits of these efforts are significant. For example, in Latin America, annual losses due to bovine brucellosis are estimated at approximately \$600 million. However, brucellosis eradication programs, though costly, have shown a high return on investment. It is estimated that for every \$1 spent on eradication, \$7 is saved due to the reduced economic burden of the disease. In the United States, the National Brucellosis Eradication Program incurred a cost of \$3.5 billion between 1934 and 1997. However, the losses in 1952 alone due to reduced milk production and abortion amounted to \$400 million, highlighting the long-term financial benefits of eradicating brucellosis (Sriranganathan *et al.*, 2009).

Conclusions

Bovine brucellosis, primarily caused by *Brucella abortus*, remains a significant global public health and economic challenge, especially in developing countries. The disease not only affects cattle but also has zoonotic potential, posing risks to humans, particularly those in high-risk occupational groups such as farmers, veterinarians, slaughterhouse workers, and dairy industry professionals. The transmission of brucellosis to humans primarily occurs through the consumption of unpasteurized dairy products, direct contact with infected animals, and occasionally, airborne transmission. Despite substantial advancements in surveillance, diagnosis, and control programs, brucellosis continues to affect livestock populations worldwide, leading to considerable economic losses. These losses stem from reduced milk production, abortion, stillbirths, culling of infected animals, and disruptions in international trade. Additionally, the costs of medical treatment for human infections and the implementation of control measures contribute to the economic burden. Vaccination remains the most effective preventive strategy for controlling bovine brucellosis, with several vaccines, such as *B. abortus* S19 and RB51, being widely used. However, challenges persist, including vaccine limitations, incomplete eradication in endemic regions, and the necessity for robust surveillance systems. The development of new vaccines, along with the improvement of diagnostic and monitoring tools, is critical for the successful control and eventual eradication of the disease. Bovine brucellosis requires a multifaceted approach, including strong regulatory frameworks, improved animal husbandry practices, public awareness, and enhanced



international collaboration to reduce its prevalence. While eradication programs have shown positive results in some regions, continued investment in research, education, and surveillance is essential for addressing the ongoing challenges posed by brucellosis in livestock and humans. In conclusion, bovine brucellosis remains a critical issue that demands sustained efforts in vaccination, surveillance, and public health management to mitigate its impact on both animal and human populations.

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IMPACT OF CLIMATE CHANGE ON MAJOR RICE INSECTS

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Abstract

Rice, a critical staple crop for over half the global population, faces mounting threats from insect pests whose dynamics are increasingly shaped by climate change. Rising temperatures, altered precipitation patterns, and elevated CO₂ levels affect pest physiology, population growth, and host interactions, exacerbating challenges for sustainable rice production. This study explores the impacts of climate variables on key pests like the brown planthopper, stem borers, and leafhoppers, alongside their interactions with natural enemies. It highlights the need for climate-resilient pest management strategies, including integrated pest management (IPM), forecasting models, and the development of resistant rice varieties. Addressing these challenges is vital to ensuring global food security.

Introduction

Rice, a vital staple crop, sustains over half the global population and is integral to food security worldwide. However, its productivity faces persistent threats from a myriad of insect pests. These pests, including notorious species like the brown planthopper (BPH), have long been a challenge for rice cultivation. With the advent of climate change, their dynamics are undergoing significant shifts, posing new challenges for sustainable rice production [1].

Climate change is altering key environmental variables such as temperature, rainfall patterns, and atmospheric CO₂ concentrations. These changes profoundly influence the behavior, physiology, and ecology of insect pests. For instance, rising temperatures can accelerate the developmental rates of pests, potentially increasing their population sizes and the frequency of infestations. Similarly, altered rainfall patterns may expand the geographical distribution of certain pests, enabling them to thrive in previously unsuitable regions. Furthermore, elevated CO₂ levels can indirectly affect pest populations by altering the nutritional profile of rice plants [2]. Changes in plant composition can impact the feeding behavior and reproductive success of pests, potentially exacerbating their effects on crop health. Such interactions highlight the complex and dynamic relationship between climate variables and pest populations.

Understanding these evolving interactions is critical for developing effective pest management strategies in the face of climate change. By addressing the ecological and physiological adaptations of pests, researchers and policymakers can work towards mitigating their impact on rice yields, ensuring the sustainability of this essential crop for future generations.

The Role of Climate Variables in Pest Dynamics

Climate change, characterized by rising global temperatures, altered precipitation patterns, increased frequency of extreme weather events, and elevated atmospheric CO₂ levels, is profoundly impacting agricultural ecosystems [3]. Among these effects, pest dynamics have shown significant shifts, influencing crop production worldwide. This overview explores how key climate variables affect pest physiology, population dynamics, and pest-host interactions, with a focus on the brown planthopper (*Nilaparvata lugens*), a major rice pest.

Temperature Effects on Pest Dynamics

Acceleration of Life Cycles : Temperature plays a pivotal role in regulating insect development, reproduction, and survival. Warmer temperatures typically accelerate the metabolic and physiological processes of pests. In the case of *Nilaparvata lugens*, elevated temperatures:

- Shorten the nymphal stage, leading to quicker generation turnover.

- Increase reproductive rates, resulting in greater pest populations over time.

For instance, research indicates that a 2–3°C increase can enable pests to complete additional life cycles annually in tropical and subtropical rice-growing regions, heightening pest pressure.

Adaptability and Geographic Shifts : While extreme temperatures above an insect's thermal tolerance can reduce survival and fecundity, many pests demonstrate adaptability. As warming progresses, pests like *N. lugens* are expanding their geographic range into previously cooler areas, posing threats to new agroecosystems.



Heat Stress Limits : Temperatures exceeding 35–40°C may lead to physiological stress, reduced feeding, and lower fecundity in pests. However, these thresholds vary by species, and some pests are evolving mechanisms to withstand higher temperatures, such as heat-shock protein expression.

Impact of Precipitation and Humidity

Drought and Pests: Rice cultivation depends heavily on consistent water availability. Drought stress often weakens rice plants, making them more susceptible to pests like leafhoppers and planthoppers [4]. Stressed plants with lower vigor provide an ideal environment for pests to thrive and proliferate.

Excessive Rainfall and Microclimates: Flooding and excessive rainfall create humid conditions that favor certain pests, such as stem borers. These pests exploit the dense canopy and moist microclimate of waterlogged rice fields, where natural predators may also be less effective due to environmental constraints.

Rainfall Variability: Changes in monsoon patterns, particularly delayed or erratic rains, disrupt pest life cycles. For instance, delayed monsoons can lead to asynchronous pest emergence and rice planting, potentially creating mismatches in pest-host availability or compounding pest outbreaks when the synchronization is favorable.

Elevated CO₂ and Pest-Plant Interactions

Altered Nutritional Quality of Crops: Increased atmospheric CO₂ impacts the chemical composition of rice plants, typically reducing their nitrogen content and increasing their carbon-to-nitrogen ratio. This results in:

- Lower protein availability in rice leaves.

- Compensatory feeding by pests like *N. lugens*, where they consume more foliage to meet their nutritional needs, causing higher crop damage.

Indirect Effects: Elevated CO₂ may also modify plant secondary metabolites and defensive compounds, potentially influencing pest feeding behavior and population dynamics. While some pests may thrive under such conditions, others may face reduced survivability depending on the host plant's altered resistance.

Impacts on major rice insects

The Brown Planthopper (BPH) (*Nilaparvata lugens*) is one of the most damaging pests of rice, directly affecting yields and causing economic losses in rice-producing regions worldwide. Its destructive nature arises from:

Direct Damage: BPH feeds on the phloem of rice plants, depleting vital nutrients and water. This results in symptoms such as wilting, stunted growth, and hopper burn—a condition where the rice plant dries up entirely [5].

Indirect Damage: BPH is a vector for viral diseases like the Rice Ragged Stunt Virus (RRSV) and Rice Grassy Stunt Virus (RGSV). These viruses severely impair rice plant growth, leading to significant yield losses.

Climate change profoundly affects BPH populations, their distribution, and pest dynamics (Increased Temperature) :

Accelerated Life Cycle: Higher temperatures shorten the developmental periods of BPH, including egg, nymph, and adult stages. This leads to faster reproduction, increasing the pest population density.

Prolonged Activity: Warmer climates extend the growing season for BPH, allowing for multiple generations in a single year.

Enhanced Survival Rates: Moderate to high temperatures reduce the mortality of eggs and nymphs, favoring population growth.

Geographic Expansion:

Range Shift: Warmer climates enable BPH to survive and thrive in regions previously unsuitable due to colder temperatures, such as higher altitudes and temperate zones.

New Threat Zones: Regions that were historically less vulnerable to BPH infestations are becoming hotspots due to changing climatic conditions.

Host-Plant Stress:

Drought Stress: Rice plants under drought conditions are more susceptible to BPH attacks. Stress weakens the plants' natural defenses, making them a more attractive and vulnerable food source.



Higher Sugars in Phloem: Stressed plants often accumulate sugars in the phloem, providing an enriched diet for phloem feeders like BPH.

Rice Stem Borers and Climate Change

Rice stem borers, including Yellow Stem Borer (*Scirpophaga incertulas*), are another group of significant pests that damage rice crops. These borers tunnel into rice stems and feed internally, disrupting nutrient and water transport, causing the characteristic symptoms of “dead hearts” and “whiteheads.”

Warmer Winters:

Reduced Overwintering Mortality: Stem borers overwinter as larvae or pupae. Warmer winters decrease the mortality rates during these dormant stages, leading to larger populations in the following season.

Prolonged Growing Seasons: Warmer climates can enable stem borers to complete additional life cycles in a year, intensifying their impact on rice crops.

Altered Phenology:

Desynchronization of Pest and Crop Life Cycles: Climate change can disrupt the synchrony between the pests’ developmental stages and rice plant growth stages. In some cases, this misalignment may intensify damage if pests emerge when crops are most vulnerable.

Extended Activity Periods: Higher temperatures allow for prolonged pest activity, leading to a sustained period of crop damage.

Increased Pest Vigorousness:

Faster Development Rates: Similar to BPH, higher temperatures accelerate the life cycle of stem borers, resulting in overlapping generations.

Higher Fecundity: Warmer climates can lead to increased egg production, exacerbating pest infestations.

Interactions with Natural Enemies

Climate change not only impacts pests but also their natural enemies, such as predators and parasitoids. For example:

Temperature Sensitivity: Predators like spiders and parasitoids like *Trichogramma* spp. may experience reduced efficacy at high temperatures.

Phenological Mismatch: As pests and their natural enemies respond differently to climate changes, synchronization may be disrupted, reducing biological control efficiency.

The decline of natural enemy populations due to habitat loss and climate extremes can lead to pest outbreaks, compounding the challenges faced by rice farmers.

Implications for Pest Management

Climate change necessitates a shift in pest management strategies to ensure sustainable rice production. Key approaches include:

Integrated Pest Management (IPM): Combining cultural, biological, and chemical methods to manage pest populations within economic thresholds.

Forecasting and Early Warning Systems: Developing climate-based models to predict pest outbreaks and guide timely interventions.

Climate-Resilient Varieties: Breeding rice cultivars with resistance to pests and tolerance to abiotic stresses.

Agroecological Approaches: Enhancing ecosystem resilience by promoting biodiversity and reducing reliance on chemical inputs.

Research Priorities and Future Directions

Understanding the nuanced impacts of climate change on rice pests requires interdisciplinary research. Key areas for future studies include:



Modeling Pest-Climate Interactions: Developing robust models to simulate pest dynamics under various climate scenarios.

Mechanisms of Adaptation: Investigating the genetic and physiological adaptations of pests to changing climates.

Farmer-Centric Solutions: Engaging with farming communities to co-develop practical, climate-resilient pest management practices.

Conclusion

Climate change poses a multifaceted challenge to rice production by altering pest dynamics in complex and unpredictable ways. Addressing this challenge requires a combination of scientific innovation, adaptive management, and policy support. By understanding and mitigating the impacts of climate change on rice pests, we can safeguard global food security and the livelihoods of millions of rice farmers.

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ROLE OF ANIMAL HUSBANDRY IN SUSTAINABLE AGRICULTURE

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Abstract

Animal husbandry plays a significant role in sustainable agriculture by supporting ecosystem services, nutrient cycling, biodiversity enhancement, and socio-economic development. When integrated with crop farming, it promotes resource use efficiency, reduces waste, and enhances the resilience of farming systems. However, the environmental challenges of greenhouse gas emissions and resource inefficiencies must be addressed through sustainable practices and technologies. This paper explores the contributions, challenges, and strategies for optimizing the role of animal husbandry in sustainable agriculture.

Introduction

The global demand for food, fiber and energy is rapidly increasing, necessitating a shift toward sustainable agricultural systems. Sustainable agriculture aims to balance productivity, environmental health, and social equity. Animal husbandry, the management and care of livestock, is an essential component of this framework. Livestock contribute to food security, provide employment, and enhance agricultural resilience. Integrated crop-livestock systems (ICLS) allow for synergistic benefits such as nutrient recycling and biodiversity conservation, making animal husbandry vital for sustainable development.

Historical Context and Current Challenges

Historically, livestock production has been integral to human society, providing food, clothing, labour, and other essential resources. Traditional farming practices, however, often led to overgrazing, deforestation, and soil degradation. In recent decades, the intensification of livestock production has further worsen these issues, with industrial-scale operations contributing to significant environmental problems.

Significance of livestock in Indian economy

Livestock plays a pivotal role in the Indian economy by providing a vital source of income and employment to millions, particularly in rural areas, and supporting agricultural operations through draught power, manure, and biogas. It significantly contributes to food security and nutrition through the supply of milk, meat, eggs, and fish, and bolsters export earnings as one of the world's largest producers of these products. The sector's substantial contribution to the agricultural GDP, coupled with its role in social security and women empowerment, underscores its economic and social importance. Additionally, livestock farming is deeply intertwined with the cultural and traditional practices of rural India, making it an integral component of the nation's socio-economic fabric.

Contributions of Animal Husbandry to Sustainable Agriculture

Nutrient Cycling and Soil Fertility

Livestock waste, particularly manure, serves as a natural fertilizer that enriches soil with essential nutrients like nitrogen, phosphorus, and potassium. The organic matter improves soil structure, enhances water retention, and fosters microbial activity. Manure application reduces reliance on synthetic fertilizers, which are energy-intensive to produce and often harmful to soil health over time (Smith *et al.*, 2020).

Crop-Livestock Integration

Integrated crop-livestock systems optimize resource utilization by integrating livestock grazing with crop production. Livestock graze on crop residues, reducing waste, while their manure replenishes soil nutrients. This cyclical process minimizes external inputs and enhances overall system productivity. For instance, grazing cover crops in rotation systems reduces soil erosion and maintains ground cover (Garrett *et al.*, 2021).

Economic and Social Benefits

Livestock provide diverse economic benefits, including milk, meat, wool, and eggs, supporting rural livelihoods. They act as a safety net during crop failures, offering a steady source of income. Moreover, animal husbandry fosters rural employment,



particularly in smallholder farming systems, and empowers women who often play a significant role in livestock care (Thornton and Herrero, 2015).

Biodiversity Conservation

Livestock grazing in silvopastoral systems—where trees, pastures, and animals coexist—enhances habitat diversity. These systems support pollinators, improve soil carbon sequestration, and reduce the pressure on forested areas for agricultural expansion (Murgueitio *et al.*, 2011).

Climate Adaptation

Livestock systems, when well-managed, increase resilience to climate variability. They contribute to carbon storage through pasture management and provide alternative income sources during climatic shocks. Additionally, drought-resistant livestock breeds are integral to maintaining productivity under changing climatic conditions (Gerber *et al.*, 2013).

Challenges in Sustainable Animal Husbandry

I. Environmental Footprint

Livestock farming contributes to greenhouse gas emissions, including methane from ruminants and nitrous oxide from manure. Globally, livestock are responsible for approximately 14.5% of all anthropogenic emissions (FAO, 2018). Intensive systems also risk overgrazing, soil compaction, and water contamination.

II. Resource Use Inefficiency

Livestock production demands significant water and land resources. Overgrazing and poor pasture management exacerbate land degradation, leading to loss of soil fertility and biodiversity.

III. Animal Health and Welfare

Intensive animal husbandry practices increase the risk of zoonotic diseases and antibiotic resistance. Unsustainable practices compromise animal welfare and pose risks to human health (Otte *et al.*, 2019).

IV. Socio-Economic Inequities

Smallholder farmers often face challenges in accessing markets, credit, and technology for sustainable livestock production. Disparities in resources and knowledge hinder the adoption of sustainable practices in low-income regions.

Strategies for Sustainable Animal Husbandry

1. Improved Feeding Practices

High-quality, locally available feeds such as Azolla and agricultural by-products enhance livestock productivity while reducing emissions. Balanced diets and feed additives, like tannins and oils, can lower methane production in ruminants (Pillai *et al.*, 2018).

2. Adoption of Silvo-pastoral Systems

Silvopastoral systems integrate livestock, trees, and pasture, providing shade, fodder, and enhanced biodiversity. These systems improve soil fertility, reduce erosion, and support carbon sequestration (Murgueitio *et al.*, 2011).

3. Circular Bioeconomy Approaches

Recycling livestock waste into biogas for energy and organic fertilizers for crops promotes a circular economy. This reduces environmental pollution and maximizes resource use efficiency (Soman *et al.*, 2020).

4. Breeding and Genetics

Selective breeding of livestock for traits like higher productivity, disease resistance, and lower methane emissions can enhance sustainability. Advances in genomics offer new opportunities for tailoring livestock systems to specific environments (Herrero *et al.*, 2021).

5. Policy Support and Farmer Training

Governments and institutions must provide incentives for adopting sustainable practices, such as subsidies for biogas plants and improved feeding technologies. Training programs can enhance farmers' capacity to implement eco-friendly practices.



Future Aspect

The future of animal husbandry in sustainable agriculture lies in innovation and collaboration. Technological advances, including precision livestock farming and low-emission feeds, will revolutionize the sector. Strengthening policies to support smallholders and integrating livestock systems with ecosystem-based approaches are critical for scaling sustainability. Research into alternative protein sources, such as lab-grown meat and plant-based proteins, may also complement livestock systems.

Conclusion

Animal husbandry is indispensable to sustainable agriculture, offering ecological, economic, and social benefits. While challenges such as emissions and resource inefficiencies persist, integrating innovative technologies, improved management practices, and supportive policies can transform livestock systems into sustainable and resilient components of global agriculture.

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GLOBAL WARMING AND ITS IMPACT ON AGRICULTURE

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Abstract

Global warming directly effect on the climate change due to this increasing temperature, drought, floods, increasing the pest and diseases and decreasing rainfall which leads decreasing yield in agricultural crops. The outcome of the “Global Warming” has now started showing its impacts worldwide. Climate is the primary determinant of agricultural productivity which directly impact on food production across the globe. Agriculture sector is the most sensitive sector to the climate changes because the climate of a region/country determines the nature and characteristics of vegetation and crops. Increase in the mean seasonal temperature can reduce the duration of many crops and hence reduce final yield. Rising global temperature is not only causing climate change but also contributing to the irregular rainfall patterns. Uneven rainfall patterns, increased temperature, elevated CO₂ content in the atmosphere are important climatic parameters which affects the crop production. In order to mitigate global warming and climate change like government policies, institutional response will enhance information flows, incentives and flexibility that promote economic development and reduce poverty that often improve agriculture adaption by innovative technologies like genetically modified crops, new varieties and carbon pricing etc.

Key words : global warming, climate change, agriculture, crop yield.

Introduction

Global warming is the ‘talk of the town’ in this century, with its detrimental effects already being brought to limelight by the recurring events of massive floods, annihilating droughts and ravaging cyclones throughout the globe. The average global temperatures are higher than they have ever been during the past millennium and the levels of CO₂ in the atmosphere have crossed all previous records. A scrutiny of the past records of 100 years indicates that, India figures in the first 10 in the world in terms of fatalities and economic losses in a variety of climatic disasters. Before embarking on a detailed analysis of Global warming and its impacts on Indian climate, we should first know what climate, green house effect and global warming actually mean. Greenhouse gases keep heat close to the earth’s surface making it liveable for humans and animals. However, global warming is happening largely due to an over-emittance of these gases and fossil fuels (natural oil, gasoline, coal). Agriculture is a cause of climate change and also suffers from the consequences. Major adverse impacts of climate change on agriculture are owing to increase in temperature; change in rainfall pattern; weather hazards, decline in soil and water quality; shifting dynamics of insects, diseases, soil flora and fauna; intrusion of sea water on land and biotic and abiotic stresses arising due to climatic extremes. There could be a few positive impacts of climate change on agriculture in some locations because of change in temperature and moisture regimes. Indian agriculture is highly prone to the risks due to climate change; especially to drought, because 2/3rd of the agricultural land in India is rainfed and even the irrigated system is dependent on monsoon rain. Flood is also a major problem in many parts of the country, especially in eastern part, where frequent flood events take place. In addition, frost in north-west, heat waves in central and northern parts and cyclone in eastern coast also cause havoc. In recent years, the frequency of these climatic extremes are getting more due to the increased atmospheric temperature, resulting in increased risks with substantial loss of agricultural production.





Global Warming

Global warming is an increase in the average temperature of the Earth's atmosphere, especially a sustained increase great enough to cause changes in the global climate. The term global warming is synonymous with enhanced green house effect, implying an increase in the amount of green house gases in the earth's atmosphere, leading to entrapment of more and more solar radiations, and thus increasing the overall temperature of the earth.

Climate Change

The global climate change may lead to melting and/or diminishing glaciers, rise in sea level and increase in the concentration of greenhouse gases. However, the most prominent environmental issue is the global warming, caused by increase in the concentration of atmospheric greenhouse gases (GHGs) i.e., carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). These GHGs trap the outgoing infrared radiation from the earth's surface and thus raise the atmospheric temperature. Recent observations show increase in temperature, occurrence of hot days, hot nights and heat waves; increasing frequency of heavy precipitation events; increased snow melt and rise in sea level. Climate change is any substantial change in earth's climate that lasts for an extended period of time. Global warming is the climate change that causes an increase in the average temperature of the lower atmosphere.

Global warming is cause, climate change is the effect

Green House Effect

Green house effect is the trapping of the long waves in the earth's atmosphere due to the effect of some gases. This trapping of the long waves causes the rise in the atmospheric temperature. The gases which causes this effect is called as green house gases. Green House effect is the phenomenon whereby the earth's atmosphere traps solar radiation and is mediated by the presence in the atmosphere of gases such as carbon dioxide, water vapor and methane that allow incoming sunlight to pass through but absorb the heat radiated back from the earth's surface. Thus, the Green house gases (GHGs) provide a blanketing effect in the lower strata of the earth's atmosphere and this blanketing effect is being enhanced because of the human activities like burning of fossil fuels etc.

Greenhouse gases, such as carbon dioxide (CO₂), methane (CH₄), water vapor and fluorinated gases act like a greenhouse around the earth. This means that, they let the heat from the sun into the atmosphere but do not allow the heat to escape back into space. The more greenhouse gases there are, the larger the percentage of heat that is trapped inside the earth's atmosphere. The earth could not exist in its present state without the presence of some naturally occurring greenhouse gases, such as CO₂, CH₄, and water vapor. Without any greenhouse gases no heat would be trapped in atmosphere, so the Cause and effect for global warming.

Almost 100% of the observed temperature increase over the last 50 years has been due to the increase in the atmosphere of greenhouse gas concentrations like water vapour, carbon dioxide (CO₂), methane and ozone. Greenhouse gases are those gases that contribute to the greenhouse effect. The largest contributing source of greenhouse gas is the burning of fossil fuels leading to the emission of carbon dioxide.

Indian Agriculture is strongly influenced by variability in weather and changes in climate. These play a significant role in India's food security and economy as it contributes nearly 35 per cent to gross domestic production (GDP). There is a general consensus that greenhouse warming would have major impact on agro-ecosystem. The atmospheric gaseous constituent which absorbs thermal radiations and cause greenhouse warming includes CO₂, CH₄, N₂O, and CFC's. Over the past-few decades, the man-induced changes in climate have become the focus of attention worldwide. The most of imminent change is the increase in the atmospheric temperature due to increased levels of CO₂ and other greenhouse gases. Increase in temperature can reduce crop duration, increase crop respiration rates and alter photosynthetic partitioning from source to sink, hasten nutrient mineralization in soils, decrease fertilizer use efficiency and increase evaporation. All of these can have tremendous impact on agricultural production and hence food security of any region. The Intergovernmental Panel on Climate Change (IPCC), a group of the world's leading climate researchers, sees a greater than 90 percent likelihood that most warming over the last 50 years has occurred because of human-caused emissions of heat-trapping greenhouse gases. Scientists say that the earth could warm by an additional 7.2 degrees Fahrenheit during the 21st century if we fail to reduce emissions from burning fossil fuels, such as coal and oil. This rise in average temperature will have far-reaching effects.

There are lists of gases which have this property of trapping long :

- Carbon dioxide
- Methane
- Nitrous oxide
- CFC
- Tetra fluoro methane
- Sulfur hexafluoride
- Carbon monoxide
- Water vapor

Carbon Dioxide: Carbon dioxide accounts for three fourths of the predicted increase in the greenhouse effect.

Water vapor: It is a naturally occurring greenhouse gas and accounts for the largest percentage of the greenhouse effect, between 36% and 90%.

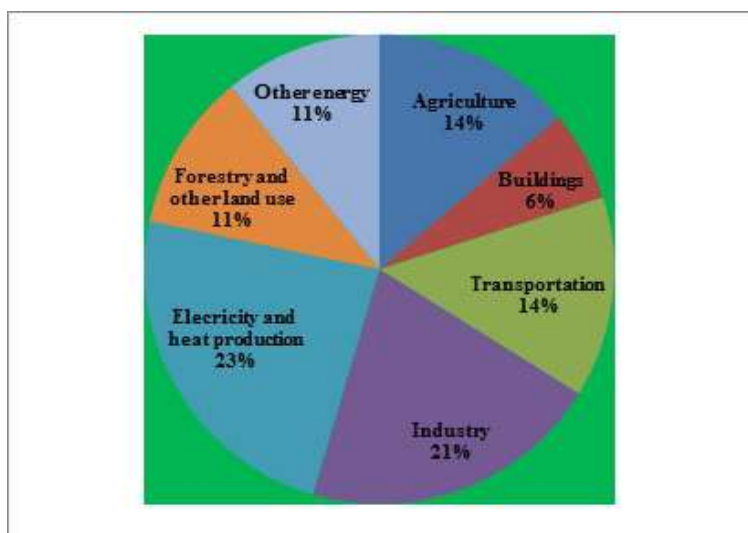
Methane: Methane is more than 20 times as effective as CO₂ at trapping heat in the atmosphere. Methane is derived from rice paddies, bovine flatulence, bacteria in bogs and fossil fuel production. Most of the world's rice, and all of the rice in the United States, is grown on flooded fields. When fields are flooded, under anaerobic conditions organic matter in the soil decomposes, releasing CH₄ to the atmosphere, mainly through the rice plants.

Nitrous oxide: Nitrous oxide (N₂O), a colorless, non-flammable gas also known as “laughing gas”, and sometimes used as an anesthetic. It is naturally produced by oceans and rainforests. Other sources of nitrous oxide include nylon and nitric acid production, fertilizers in agriculture, cars with catalytic converters and the burning of organic matter. Nitrous oxide is broken down in the atmosphere by sunlight.

Chlorofluorocarbon (CFC): is an organic compound that contains only carbon, chlorine, and fluorine, produced as a volatile derivative of methane, ethane, and propane. They are also commonly known by the DuPont brand name Freon.

Carbon monoxide: is a colorless, odorless, and tasteless gas that is slightly less dense than air. It is toxic to hemoglobin animals (including humans) when encountered in concentrations above about 35 ppm, although it is also produced in normal animal metabolism in low quantities, and is thought to have some normal biological functions. In the atmosphere, it is spatially variable and short lived, having a role in the formation of ground-level ozone.

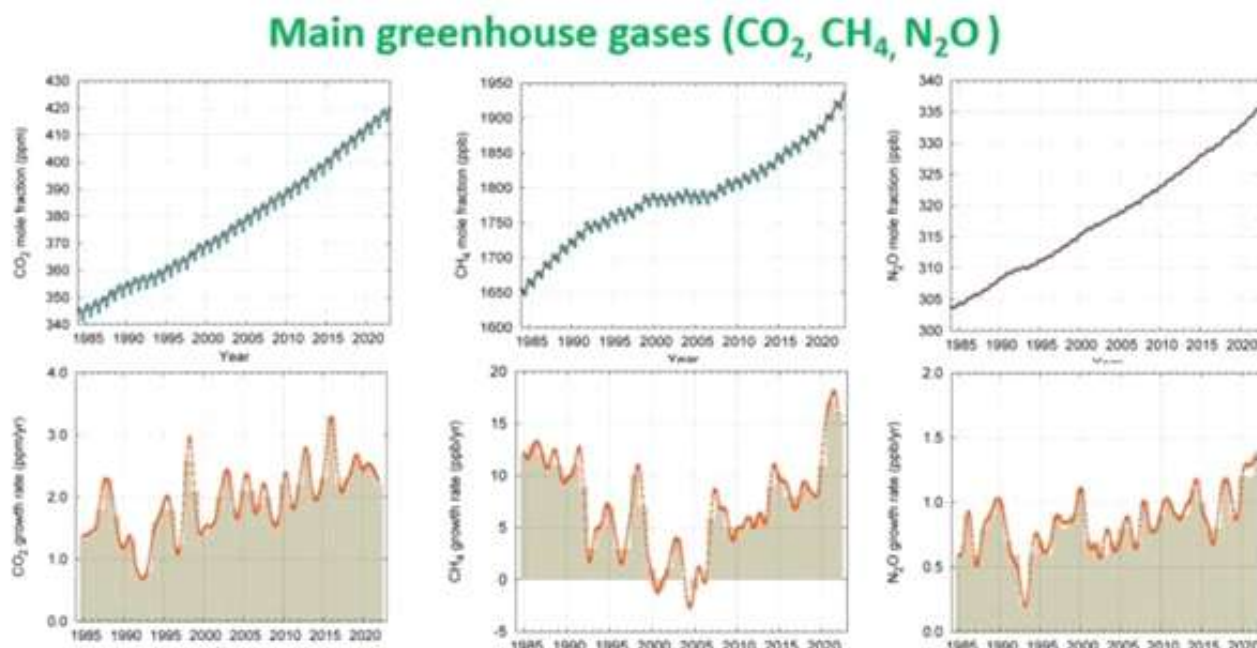
Annual greenhouse gas emission:



Contribution of different sectors in world to global warming

In this figure the electricity and heat production which contribute 23 % of GHG's in the world to Global warming, this followed by Industry sector which contribute 21 % of GHG's in the world to Global warming, which followed by Agriculture, Transportation, Forestry and other land use, other energy and Buildings.

In this figure shows the trends for greenhouse gases: Carbon dioxide (CO₂), nitrous oxide (NO₂) and Methane (CH₄) concentrations in the atmosphere are still increasing. All the green house gases are increasing over the years. In case of carbon dioxide (CO₂) initial year it was CO₂ 338 ppm concentration in atmosphere over year it shows increasing trends and in the year of 2020 it was reaches 420ppm of CO₂ concentration in atmosphere.



World scenario of greenhouse gas emission (1985-2020)

Top10 greenhouse gas emitters in the world

In top ten emitters of greenhouse gas in the world, where China stand first place which contribute 24 per cent of the total green house gas in the world, followed by USA Stand second place which contribute 12 per cent of the total green house gas in the world. Where India stand fourth place which contribute 6 per cent of the total green house gas in the world. In per capita emission of greenhouse gas in the world, where Canada stand first place which contribute 24 t-CO₂-eq of the total green house gas in the world, that followed by USA Stand second place which contribute 19 t-CO₂-eq of the total green house gas in the world. Where India which contribute 1.9 t-CO₂-eq of the total green house gas in the world, similarly Russia, Japan, Europe, Indonesia, China, Brazil, Mexico and Per capita emission of GHG from different countries like 16, 8.5, 8, 8, 7.5, 7, 6 t-CO₂-eq respectively. The gases released from industry and agriculture (known as emissions) are adding to the natural greenhouse effect, the way the Earth's atmosphere traps some of the energy from the Sun. Major GHGs are CO₂, CH₄, N₂O etc. Human activities such as burning fossil fuels like coal, oil and natural gas are increasing the amount of carbon dioxide (CO₂), the main greenhouse gas responsible for global warming (70%). The concentration of CO₂ in the atmosphere is now higher than at any time in the last 60 years.

Conclusion

Global warming is an increase in the global average temperature due to high concentrations of CO₂ and other gases linked to human activity. Global warming directly effect on the climate change due this increasing temperature, drought, floods, increasing the pest and diseases and decreasing rainfall which leads decreasing yield in agricultural crops. In order to mitigate global warming and climate change like government policies, institutional response will enhance information flows, incentives and flexibility that promote economic development and reduce poverty that often improve agriculture adaption by innovative technologies like genetically modified crops, new varieties and carbon pricing etc.



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Abstracts



AGRO-MORPHOLOGICAL DIVERSITY OF BLACK-SEEDED LENTIL COLLECTION OF UTTARAKHAND HIMALAYAS

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Abstract

Black seeded lentil adapted to Uttarakhand Himalayas and being cultivated in the region over generations owing to the preference of local communities for their adaptability in the fragile Himalayan agroecosystem, superior nutritional and nutraceutical value, unique taste and culinary uses. The present dataset comprises 73 native black seeded lentil germplasm accessions including 3 checks (VL Masoor 125, VL Masoor 126 and VL Masoor 148) collected from fragile agroecosystem of Uttarakhand Himalayas. This set was evaluated for 8 quantitative and 9 qualitative traits during 2022-23 and 2023-24 *Rabi* season. As per the pooled data of 2 years, a wide range of variability was observed among accessions for days to 50% flowering (87-98), pod length (1.0-1.16 cm), secondary branches (2-4), plant height (21-35 cm), number of pods/plant (25-74), days to maturity (142-151), grain yield/plant (12.50-97.50 g) and 100 seed weight (1.49-2.46 g). Among various agro-morphological traits, number of pods/plant (0.72), plant height (0.68), secondary branches (0.49), days to maturity (0.43) and pod length (0.26) were found major yield contributing traits as they exhibited highly significant correlation with grain yield/plant. Principal components PCI & PCII with eigen value > 1 accounted for 43.61% and 16.50% of the total variation, respectively. Accessions IC 201727 (1,413 kg/ha), IC 127577 (1,304 kg/ha) and IC 201798 (1,304 kg/ha) were found promising grain yield and can be utilised in the development of improved lentil varieties for hill region.

IDENTIFICATION OF GERMPLASM SOURCES RESISTANT TO ROOT ROT OR AERIAL BLIGHT IN SOYBEAN CAUSED BY *RHIZOCTONIA SOLANI* KÜHN

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Abstract

Soybean (*Glycine max* (L.) Merrill) holds significant importance in Indian agriculture, particularly as a vital oilseed crop. Recent past years, the soilborne pathogen *Rhizoctonia solani* has emerged as a significant threat to Indian soybean cultivation. This pathogen inflicts substantial yield losses by targeting seedlings, causing root rot, and affecting younger plants by inducing aerial blight. Currently, no commercial soybean cultivar has been reported to exhibit resistance to this disease. In present study, 107 elite soybean germplasm lines were evaluated in epiphytotic field conditions and selected 31 germplasm lines were evaluated in controlled condition to identified resistance sources. In epiphytotic field conditions, most of the genotypes exhibited a susceptible response to *R. solani*. However, the genotype IC 415047 showed the lowest disease incidence, with no significant difference observed when compared to eleven other genotypes: VPSM 117, UPSL 390, IC 073710, VPSM 1096A, AGS 25, UPSL 63, and EC 390981, CAT 734, UPSL-50981, EC-456613 and EC-456647 in epiphytotic field conditions. Selected thirty one genotypes further evaluated in controlled condition through root inoculation method. Interestingly, genotypes CAT 734, VPSM 117, IC-073710, UPSL-50981, EC-456613 and EC-456647 showed moderate resistance reaction toward *R. solani*. Additionally, agronomic traits, including grain yield, 100-seed weight, number of pods per plant, and pod weight, were evaluated under epiphytotic field conditions and dry root weight and biochemical characteristics were analyzed under controlled conditions following inoculation with *R. solani*. Principal component analysis revealed that moderate resistance genotypes were positively associated with root and biochemical traits. Correlation analysis revealed that area under disease progress curve was significantly negatively associated with any grain yield and number of pods per plant in epiphytotic field condition, where as in controlled condition percentage disease index was significantly negatively associated with dry root weight. These moderately resistant germplasm lines hold apparent for use in breeding programs aimed at developing



high-yielding, root rot resistant varieties. They can also serve as valuable resources for creating mapping populations to identify genes or quantitative trait loci (QTL) associated with resistance traits.

ASSESSMENT OF SOIL QUALITY UNDER DIFFERENT LAND USE TYPES IN SOILS OF ANAND DISTRICT

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Abstract

The research study was taken in the soils of eight talukas of Anand district in Gujarat to measure the soil quality assessment under different land use systems. The representative soil sample collection was performed from all land use type of the district viz., agriculture land (rice-tobacco cropping system), problematic land (saline soil), forest land (mixed type), horticulture land (sapota orchard) and pasture land (grassland) and GPS coordinates were noted. Soil samples were collected from different depths i.e., 0-15, 15-30, 30-45, 45-60, 60-75 and 75-90 cm under each land use type. The physical, chemical and biological soil quality parameters were assessed from each land use type. The investigation resulted that texture varied from loamy sand to clay loam. The highest mean value of BD (1.45 Mg/m^3) was observed in saline soil. Whereas, PD (2.39 Mg/m^3) in R-T cropping system. The highest mean value of porosity (45.06 per cent) and MWHC (49.77 per cent) was observed in forest soil. The highest mean value of hydraulic conductivity (8.66 cm/hr), soil water diffusivity ($2.38 \text{ cm}^2/\text{min}$) and infiltration rate (4.50 cm/hr) were observed in forest soil. The pH was alkaline in all the soils and EC was medium to high with respect to salt accumulation. The highest mean value OC (7.75 g/kg) was found in forest soil. The highest mean value of available N (159.41 kg/ha) and phosphorous (46.87 kg/ha) was observed in R-T cropping system whereas, available potassium (512 kg/ha) was observed in problematic soil and available sulphur (15.00 mg/kg) in forest soil. Further, highest mean value of CEC 12.00 (me/100g) , exch. Ca ($10.92 \text{ me/100g of soil}$), exch. Mg ($10.20 \text{ me/100g of soil}$), exch. Na ($2.16 \text{ me/100g of soil}$) and exch. K ($0.182 \text{ me/100g of soil}$) were observed under saline soil. The highest mean value of available Fe in soil (3.19 mg/kg) was observed in R-T cropping system whereas, available Zn (1.32 mg/kg) under problematic soil. The highest mean value of Cu (0.60 mg/kg) and Mn (1.84 mg/kg) was observed in grassland. Among the different land use systems, the enzyme activity decreased with increase in soil depth. The highest mean value of dehydrogenase activity ($937.00 \text{ g TPF/g min}$), acid phosphatase activity ($29.50 \mu \text{ moles/g}$) and alkaline phosphatase activity ($112.96 \mu \text{ moles/g}$) were observed under forest land.

PHYTOCHEMICAL COMPOSITION AND THERAPEUTIC POTENTIAL OF HONEY: A COMPREHENSIVE REVIEW OF BIOACTIVITIES AND HEALTH BENEFITS

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Abstract

Honey has been prized since ancient times for its therapeutic and healing properties, revered by cultures worldwide for its natural medicinal benefits. This review provides a comprehensive overview of the phytochemical composition and bioactivities of honey, focusing on samples produced from various plant species across the world. Vegetative diversity, influenced by climatic and geographical factors, plays a crucial role in the variety of honey produced in different regions. The diversity in plant species leads to the production of honey with unique phytochemical profiles, contributing to various health benefits. While research on the phytochemical composition and bioactivity of honey is increasing, studies from India remain limited. Honey's antimicrobial properties are attributed to a range of bioactive compounds, including sugars, flavonoids, non-flavonoid polyphenols, hydrogen peroxide, 1,2-dicarbonyl compounds, bee defensin-1, and other biomarkers. These compounds, present in varying concentrations depending on the nectar source, bee type, and storage conditions, work synergistically to combat a broad spectrum of microorganisms, including bacteria, fungi, and other pathogens, and may also help modulate their resistance to antimicrobial agents.

The therapeutic potential of honey, primarily due to its antioxidant and antimicrobial properties, has garnered increasing



interest in recent years. Studies on its phenolic and enzymatic components have provided insights into its mechanisms of action, highlighting its potential for wound healing, anti-inflammatory activities, and other therapeutic effects. Honey's bioactive compounds have been linked to apoptosis and cell proliferation inhibition in various cancer cell lines, positioning honey as a promising natural product for therapeutic use in reducing tumour growth. This review also discusses the antioxidant activities of honey, highlighting its value as a natural remedy in the fight against infections and diseases, particularly in regions with a diverse range of plant species.

ECO-FRIENDLY UTILIZATION OF POULTRY FEATHER WASTE: TRANSFORMING KERATIN INTO ORGANIC FERTILIZERS

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Abstract

The global poultry sector has grown rapidly in recent years. On one hand, this industry is fulfilling the food demand of a growing population but on the other hand, it is generating a significant amount of non-biodegradable feather waste. When openly disposed of, these feathers resist degradation even by enzymes like trypsin and pepsin, causing a global environmental issue. Traditionally, feathers have been often disposed of through incineration or dumping with other wastes, methods that inhibited biodegradation by soil microbes. These approaches are energy-intensive and result in the loss of vital protein keratin, the primary protein in chicken feathers. However, keratinolytic bacteria offer a sustainable solution by breaking down keratin in feathers, paving the way for producing cost-effective, eco-friendly, and readily available sources of nitrogen (N) and minerals as organic fertilizers. This biofertilizer, derived from feather hydrolysate, can promote plant growth, enhance plant protein, amino acid, and chlorophyll content, and improve soil properties such as water retention, carbon levels, and mineral content. This review provides an in-depth analysis of current research on converting chicken feathers into valuable organic fertilizers.

ROLE OF HONEYBEE POLLINATION IN MUSTARD PRODUCTION

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Abstract

Mustard (*Brassica* spp.), is an important oil seed crop, cultivated for edible oil throughout the country with average productivity of 1397 kg/ ha. Honeybees (*Apis mellifera*) are the only pollinators which can be reared in bee boxes and moved from one place to another place, installed in the field for pollination as and when needed. Cross pollination of entomophilous crops by honeybees is considered as one of the effective and cheapest method for triggering the crop yield both qualitatively and quantitatively. Being the pollination service provider bees contribute handsomely in enhancing the productivity and production of cross pollinated crops through efficient pollination in an inconspicuous and silent manner. In the country, mustard seed is mainly grown in north western parts of India, Rajasthan and Uttar Pradesh are the major producing states in the country. In order to evaluate pollination technology in Mustard crop under irrigated condition the use of two honeybee boxes per acre in mustard crop (RP) different location of Krishi Vigyan Kendra, Rewa (MP) on 05 famers' field with two treatments in 2023 to 2024. To evaluate the performance of recommended practice in mustard crop use of two honeybee boxes per acre in mustard crop (RP) and compared with farmers practices (FP) was found less pollination than recommended practice (RP). Economics and benefit cost ratio of both FP and RP plots were worked out. The number of siliqua per plant was recorded highest in RP (178), while 152 was recorded in FP. Rs. 46951.00/ha was recorded net profit under RP while in FP it was Rs. 29487.00/ha was recorded. Benefit cost ratio was 3.02 under RP, while 2.72 was in FP. The technology of honeybee pollination is found most suitable for increasing the number of siliqua per plant in mustard crop and most economic for the increasing the yield than farmers practices.



STUDIES OF SURFACE CHARGE DENSITY AND ANTIMICROBIAL ACTIVITY OF BARIUM MOLYBDATE SYNTHETIC MEMBRANE

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Abstract

The parchment supported barium molybdate synthetic membrane was prepared by the ion interaction method. The electrochemical observation was done by potentiometer, which shows that the membrane is cation selective. The theoretical value of charge density for the membrane was evaluated from membrane potential using different approaches proposed by Teorell–Meyer–Sievers, Kobatake and Nagasawa, which are comparable with the observed values. The other important parameters like transport number, mobility ratio, charge effectiveness are also calculated by observed potential values. The membrane was tested for its antimicrobial activity against gram-negative and gram-positive bacteria. The membrane was characterized by using Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Fourier transform infrared (FTIR) spectroscopy, Thermogravimetry analysis (TGA)/ Differential thermal analysis (DTA) and X-ray diffraction (XRD) analysis.

STUDY OF HETEROSIS AND COMBINING ABILITY FOR YIELD AND ITS COMPONENTS IN PUMPKIN (*CUCURBITA MOSCHATA* DUCH. EX. POIR)

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Abstract

Heterosis and combining ability are two important considerations in the utilization of heterosis, which can be used to generate excellent hybrid resource candidates and is very important in conventional hybrid breeding. The research entitled “Study of heterosis and combining ability for yield and its components in pumpkin (*Cucurbita moschata* Duch. Ex. Poir),” was carried out at the Vegetable Research Centre of G.B. Pant University of Agriculture & Technology, Pantnagar, Udham Singh Nagar, Uttarakhand, during the summer season of 2023 and 2024. Eight distinct genotypes of pumpkin namely PPU-1, PPU-2, PPU-3, PPU-4, PPU-5, PPU-6, PPU-7, and PPU-8, were selected and crossed in 2022 using a diallel mating design (apart from reciprocals) in order to produce 28 F₁ crosses. With a spacing of 3 m × 0.60 m, the parents and F₁ were sown in a randomized complete block design with three replications. Among the parents and hybrids, there were highly significant differences, according to the analysis of variance for qualitative as well as quantitative traits. The findings of the analysis of variance for combining ability showed that both GCA and SCA variances were significant for all characters. For most of the characters such as fruit yield per plant and number of fruits per vine, parental lines namely PPU-2, PPU-5 and PPU-7 were effective general combiners. The crosses namely PPU-2 × PPU-5, PPU-5 × PPU-7, PPU-1 × PPU-8, PPU-5 × PPU-6 and PPU-1 × PPU-8 were observed to be continually excellent specific combiners for the majority of the traits studied. The crosses PPU-2 × PPU-5 (554.20 q/ha) and PPU-5 × PPU-7 (495.05 q/ha) were found to be the most effective heterotic combinations as compared to check (Narendra Agrim, 328.34 q/ha). These particular crosses may be exploited as commercial hybrids after successful and repeated evaluation in multilocation trial and such hybrids and parental lines of pumpkins would make great prospects for commercial application.

DEVELOPMENT AND EVALUATION OF SALT TOLERANT PGPR BACTERIA ON GROWTH PERFORMANCE OF WHEAT CROP

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Abstract

Soil salinity is an issue of global importance causing many socio – economic problems. It causes not only economic losses but



also reduces the productivity of land. PGPR bacteria with salinity tolerance characters may be used for making these soil productive without any chemical treatment. For this 24 bacterial isolates viz., *Bacillus* sp. (BS1, BS2, BS3, BS4, BS5, BS6,); *Pseudomonas* sp. (PS1, PS2, PS3, PS4, PS5, PS6, PS7), *Azotobacter* sp. (AZT1, AZT2, AZT3, AZT4) and *Azospirillum* sp. (AZS1, AZS2, AZS3, AZS4, AZS5, AZS6, AZS7) were obtained from stock culture of Department of Microbiology, College of Basic sciences and Humanities, Dr. PCAU, Pusa, Bihar. After that their response for salinity stress, different concentrations (0mM, 60mM, 120mM, and 180mM) of NaCl was used. It was observed that 75% bacterial isolates showed salinity tolerance upto 120 mM concentration and only 30% isolates showed salinity tolerance to 180mM. Further these isolates were screened for PGPR characters (P,K&Zn solubilization and Siderophore & IAA production) and found that 60% isolates showed P solubilization, 50% isolates showed K& Zn solubilization, 40 % isolates showed siderophore and IAA production activities. Further a consortium of promising salt tolerant bacteria with PGP characters was developed and their effect was evaluated on wheat crop under different NaCl salinity levels. A pot experiment was conducted and crop growth parameters and stress behavior (Superoxide dismutase-SOD) activity, soil nutrient status & electrical conductivity were assessed. It was observed that there is significant increase in crop growth and 15% more yield in those treatments containing 120-180mM NaCl and consortia as compared to control. Also there is decrease in salinity was observed in consortia inoculated soil after harvest.

PROBLEMS AND PROSPECTS OF CULTIVATION OF KHASI MANDARIN AND ITS IMPORTANCE IN NORTHEASTERN HIMALAYAN REGION

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Abstract

Northeast India, an important part of the Indo-Burma biodiversity hotspot is one of the 36 global biodiversity hotspots and center of origin for various Citrus species. Among the Citrus crops available in northeastern region, Khasi mandarin is the most economically important one and plays a vital role in the socio-economic development of the people in this region. Oranges have been well established for its therapeutic value and have long been utilized in conventional herbal medicine. Experimental studies show that its bioactive compounds possess antibacterial, antimicrobial, antiviral, antioxidant, anti-cancerous properties, which clearly indicate the potential of the crop in pharmaceutical industry. Although India is fourth largest producer of orange in the world but due to the citrus decline problem, the average yield of orange in India is alarmingly low as compared to other countries. The major cause of citrus decline is the prevalence of insect/ pest, fungal, bacterial and viral diseases often becomes a major constraint in mandarin production. General negligence, mixed planting, improper spacing, infection of *Phytophthora* root rot, gummosis, powdery mildew, canker, scab diseases and attack of insects and pests like borers, aphids, scales, mites, leaf miners are common in mandarin oranges, resulting in severe decline in the region.

HISTOPATHOLOGY AND MOLECULAR CHARACTERIZATION OF BHV-1 IN BUFFALOES

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Abstract

Infectious bovine rhinotracheitis (IBR), caused by Bovine herpesvirus 1 (BHV-1), is a highly contagious viral disease affecting cattle and buffaloes. The disease is characterized by symptoms such as fever, loss of appetite, respiratory distress, difficulty breathing, conjunctivitis, nasal discharge, and in severe cases, abortions. The focus of the current study was on a buffalo dairy farm experiencing a high mortality rate. The buffaloes on the farm exhibited elevated rectal temperatures, conjunctivitis, severe respiratory distress, and nasal discharge. Tissue samples were collected from the upper respiratory tract



following postmortem examinations of the affected buffaloes. Tracheal tissue samples were then processed for histopathology and DNA isolation. The presence of BHV-1 virus in the tissue samples was confirmed using nested PCR with glycoprotein B gene (gB) primers. This investigation represents the first documentation of the clinical signs, postmortem lesions, histology, and DNA detection of the BHV-1 gB gene using a nested PCR technique during an active epidemic among buffaloes in India. The findings of this study will be valuable in improving the detection of BHV-1 in the future, ultimately helping to reduce financial losses within the dairy industry.

GENETIC DIVERSITY ASSESSMENT OF MUNGBEAN GENOTYPES USING SSR MARKERS

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Abstract

This study investigated the molecular genetic diversity of 36 mungbean genotypes using DNA-based Simple Sequence Repeat (SSR) markers at the Department of Plant Breeding and Genetics, Bihar Agricultural University. Applying neighbour-joining Unweighted Pair Group Method with Arithmetic Mean (UPGMA) clustering via DARwin 6.0 software, we analyzed 30 SSR amplification profiles, of which 7 were found to be polymorphic. The maximum observed expected heterozygosity (He) and polymorphic information content (PIC) were 0.48 and 0.37, respectively. The analysis revealed a range of genetic dissimilarity indices among genotypes, with a maximum value of 0.30 and a minimum of 0.07. The cluster analysis presented a dendrogram categorizing the genotypes into three major clusters: one cluster comprising 3 genotypes, another having 20 genotypes divided into two subgroups, and the last consisting of 13 genotypes with three subgroups. Notably, the CEDAAG002 marker, with the highest PIC of 0.37, emerged as a key marker for distinguishing the 36 mungbean genotypes. Overall, our findings indicate a low level of genetic diversity within the tested mungbean germplasm and underscore the need for additional primer screening to enhance the understanding of molecular diversity in these genotypes. Moreover, the study demonstrated the efficacy of utilizing adzuki bean SSR markers in the molecular diversity analysis of mungbean.

EMPOWERMENT OF WOMEN AND ENVIRONMENTAL SUSTAINABILITY THROUGH SELF HELP GROUP ACTIVITIES: A STUDY IN MANDI DISTRICT OF HIMACHAL PRADESH

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Abstract

Encouragement of business and income-generating activities is an excellent approach to empowering women, with Self Help Groups (SHGs) and microfinance programs playing a crucial role in this process. SHGs not only aid in poverty eradication and the empowerment of disadvantaged women but also contribute to sustainable development by promoting environmentally friendly practices in rural areas. This study was conducted in the Sadar Mandi block of Mandi District, Himachal Pradesh, covering 10 panchayats with the highest number of SHGs under the NRLM program. A sample of 15% women respondents, totalling 403, was randomly selected from each panchayats. Data were collected using a purposive sampling method and analyzed with SPSS software for accuracy.

The majority of respondents were aged between 30-40 years, had a metric level of education, and were primarily engaged in agriculture. Findings revealed that most respondents had not undergone training provided by the government or other agencies, although they recognized the importance of training for skill development. Women who regularly attended SHG meetings reported improvements in communication skills, confidence, and awareness of sustainable agricultural practices, such as organic farming, water conservation, and the use of eco-friendly techniques.

This study highlights the potential of SHG activities to integrate environmental sustainability with economic empowerment. By incorporating training on environmental practices and promoting eco-conscious entrepreneurship, SHGs can not only uplift women economically but also contribute to preserving natural resources and combating climate challenges.



DEVELOPMENT OF EXPERT SYSTEM FOR SMART IRRIGATION USING INTERNET OF THINGS

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Abstract

Irrigation is very important in agriculture for crop production. Efficient water management plays an important role in the irrigated agricultural cropping systems for better crop production. The proposed expert system (ES) for smart irrigation using Internet of Things (IoT) is an automated irrigation system that operates on getting decisions on the condition of soil moisture. It operates on sensor based soil moisture condition to control automated irrigation whenever soil moisture level decreases, this ES directs the valve to change its position from Off to On and if the soil moisture level is go to the proper pre-defined value at that time system is get Off automatically. The design of this a micro-controlled computer based ES for irrigation mainly have four components such as a database, knowledge base, graphic user interface (GUI) and sensor based system using Arduino uno or Raspebery Pi microcontroller. The database and knowledge base are developed in structured query language (MySQL) and GUI in dotNet softwares and machine learning algorithm in Python is used for making this expert system more user friendly and robust. This system must be able to control the Valve of water tank automatically based on pre-programmed conditions. An application delivery controller (ADC) connected to micro controller to collect soil moisture at various locations in the field. This expert system (ES) contains a strong database, knowledge base and GUI with microcontroller based ADC for providing decisions to operate valve of water tank to automate irrigation in the agricultural field. This ES for smart irrigation saves water to irrigate crops in the field. So the farmer may get more crop production in less water that ultimately the income of farming community is increased.

FERROPTOSIS AND CANCER GENOMICS: NEW HOPE IN ANIMAL HUSBANDRY

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Abstract

Ferroptosis is a process involves non-apoptotic form of regulated cell death. It is characterized by the accumulation of iron-dependent membrane-localized lipid peroxides. It is an innate tumour suppression mechanism. It involves ferrous iron accumulation, free radical formation and dysfunction of antioxidant system and lipid peroxidation. PUFA-PLs are susceptible to peroxidation as they contain bis-allylic moieties. Fenton reaction occurs when the oxidation of PUFA-PLs takes place either by enzymatic or non-enzymatic reactions. Cytochrome P450 oxidoreductases and ALOX lipoyxygenase are involved in the lipid peroxidation (Zhou *et al.*, 2024). Tumor suppressors like p53, fumarate hydratase, BRCA1-associated protein 1 (BAP1) and Kelch-like ECH-associated protein 1 (KEAP1) exhibit tumour suppression functions in tumour cells by induction of ferroptosis. However, ferroptosis induces the release of 8-OHG from the cells of pancreas. The released 8-OHG promotes the STING-dependent DNA sensor pathway that aggravates the infiltration and M2 polarization in macrophages. It facilitates progression of pancreatic carcinogenesis (Zhou *et al.*, 2024).

Mutations in the genes like NRAS, KRAS, TP53, DIS3, FAM46C, and BRAF have found in multiple myeloma patients in human beings. Understanding and targeting the genes to enhance or suppress ferroptosis will open new hope in cancer genomics to treat the patients. Therapeutic drugs can be targeted in the similar line will add the effects to treat patients. Even its application in veterinary science is in infancy, further innovations will pave the path towards successful farming. It is noted that anti-cancer properties are seen by promoting ferroptosis in malignant cells, but causes damage to normal cells producing diseases. Thus, this mechanism is called as double-edged sword (Wang *et al.*, 2024) and hence further research will facilitate to discover its therapeutic usage in veterinary science.



PREPARATION OF ARTIFICIAL MEMBRANE: AN ASSESSMENT OF EXPERIMENTAL AND THEORETICAL APPROACHES THROUGH ELECTROCHEMICAL PARAMETERS

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Abstract

In this work, the ion-interaction method was employed using Iron (III) chloride (FeCl_3) and sodium tungstate (Na_2WO_4), to prepare a Iron tungstate artificial membrane. Physical and electrochemical properties of the membrane were investigated in order to evaluate the key parameters like membrane potential, bi-ionic potential and electrical conductance. The membrane was found to have the optimal properties, with good water uptake, transport properties and excellent permselectivity. Electrochemical measurements have been carried out in different alkaline earth metal divalent electrolytes such as MgCl_2 (aq), CaCl_2 (aq) and BaCl_2 (aq) at different concentrations to figure out the correlation between effective fixed charge density and transport properties of the membrane. The study reveals that the Iron tungstate membrane shows higher cation-selectivity towards Ba^{++} ion. The effective fixed charge density was found to follow the order $\text{Ba}^{++} > \text{Ca}^{++} > \text{Mg}^{++}$. This newly developed membrane can be considered as excellent candidate suitable for water treatment by electrodialysis.

EVALUATION OF ANTAGONISTIC RHIZOBACTERIA FOR BIOCONTROL OF *FUSARIUM VERTICILLIOIDES* AND GROWTH PROMOTION IN MAIZE

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Abstract

Sixty one out of 200 isolates, isolated from maize rhizospheric soils, were found to be effective to control the mycelial proliferation of the test pathogen *Fusarium verticilloides*, maximum being with MRB5 (45.7%) and MRF8 (41.3%) in dual culture plate. Growth inhibition of the phytopathogen was also recorded by diffusible and volatile antifungal metabolites produced by the isolates. Further screening revealed that all isolates showed ammonia production while only 12 isolates were recorded for Hydrogen cyanide (HCN) production. In addition to their antifungal capabilities, the isolates were evaluated for plant growth-promoting properties, specifically their abilities to solubilize phosphorus (P) and zinc (Zn), produce indole-3-acetic acid (IAA), and generate siderophores. These traits contribute to enhanced nutrient availability, root development, and stress resistance in plants, thereby supporting overall plant health. These isolates were tested for inter-compatibility and four potent antagonists (MRB5, MRF8, MRP4 and MRL3), selected based on antagonistic traits were evaluated under greenhouse conditions to control seed rot and seedling blight in maize variety PMH14. Results showed that these isolates significantly improved maize seedling emergence rates: MRB5 and MRF8 both achieved an 80% emergence, compared to 60% emergence in untreated control group. This study highlights the potential of certain rhizobacteria not only in controlling fungal pathogens but also in promoting plant growth, suggesting they could be valuable candidates for developing sustainable biocontrol agents in agriculture.

PREVALENCE AND TREATMENT STRATEGIES FOR ANAPLASMOSIS IN BOVINES WITHIN WESTERN UTTAR PRADESH

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Abstract

Bovine anaplasmosis is a disease transmitted by ticks, caused by an obligate intra- erythrocytic parasite. This condition is increasingly affecting dairy animals and results insubstantial economic losses for the dairy sector, particularly in developing

country such as India. The present study was conducted during an animal health camp organized in the Western Uttar Pradesh region as part of the IFFCO Project titled “Mobile Veterinary Clinical Services for Dairy Animals in Western Uttar Pradesh”. Among 230 bovines suspected of tick infestations, clinical evaluations indicated that the animals exhibited weakness, weight loss, lethargy, poor appetite, reduced milk production, fever, recumbency, and pale mucous membranes. Further examination revealed dehydration and anaemia in the affected animals. Blood samples were collected aseptically from the jugular veins, and hematological assessment indicated anaemia (Haemoglobin 10.15 ± 0.76 g/dl) and low albumin levels (2.50 ± 0.61 g/dl). Giemsa-stained thin blood smears confirmed the presence of *Anaplasma* species parasites in the red blood cells of 95 out of the 230 animals examined. On the first day, the anaplasma-positive animals received treatment with Oxytetracycline-LA at a dosage of 20 mg/Kg body weight via intramuscular injection, along with Inj. Flunixin meglumine at dosage of 1.1-2.2 mg/kg body weight, and supportive therapies including iron supplements, Methylcobalamine, and a mineral mixture in recommended dosages. Of the 95 animals, 25 did not fully recover within 72 hours. After this period, the same treatment regimen was administered to the remaining suspected animals. All treated animals responded positively to the therapy and showed recovery within six days. The study identified a prevalence rate of 41.30 percent for anaplasmosis in the Western Uttar Pradesh region, which is attributed to tick infestations and inadequate management practices, which can be successfully managed by aforesaid treatment strategies.

TOXICITY STUDY OF POLYHERBAL FORMULATIONS CONTAINING *TRIGONELLA FOENUM-GRACUM*, *MOMORDICA CHARANTIA*, *SYZYGIUM CUMINI* AND *CATHARANTHUS ROSEUS* IN WISTAR RATS.

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Abstract

This study aimed to evaluate the adverse effects of polyherbal formulations containing varying concentrations of extracts from *Trigonella foenum-graecum*, *Momordica charantia*, *Syzygium cumini*, and *Catharanthus roseus* in Wistar rats. This study evaluated the potential adverse effects of two Polyherbal Formulations (PHF I and PHF II) on Wistar rats over a 30-day period. Three groups were analysed: a control group, a PHF I group (400 mg/kg), and a PHF II group (400 mg/kg). The formulations were administered orally, and the animals were monitored for toxic symptoms related to body weight, hematological, and biochemical parameters. Results indicated no toxic symptoms, with all animals surviving without fatalities. On the 30th day, blood biochemical parameters were measured, and the liver, kidney, and pancreas were examined histopathologically. The subacute toxicity study revealed no significant changes in body weight, food and water intake, hematological parameters, or liver and kidney functions compared to the control group. Additionally, no histopathological evidence of pathological lesions was found in the vital organs. These findings suggest that both PHF I and PHF II, even at high dosages, did not produce any mortality in Wistar rats.

A PROMISING KABULI CHICKPEA GENOTYPE AKGK-1801 SUITABLE FOR MECHANICAL HARVESTING FOR MAHARASHTRA STATE

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Abstract

Chickpea is most important *rabi* pulse crop globally having about 18.09 million tonnes production across 55 countries (FAOSTAT 2022). India shares 68.05% area and 75.00% production in the World. India is the largest producer of chickpea (13.54 MT) in the world. In Maharashtra it occupied 28.30 lakh ha area with production of 32.40 lakh tons having average



productivity of 1145 kg/ha (2022-23) In Vidarbha region also increase area 9.23 lakh ha. and productivity 1220 kg/ha .Now the trend is being changed, due to labor problem, number of farmers demanding the tall growing genotype suitable for mechanical harvesting, so this unit developed genotypes and tested at University ,State and National level along with Agronomic and plant protection measures. Genotype AKGK-1801 showed higher seed yield, while conducting different trials over the zonal, National , and local checks. The experiment was carried out at different regions of Maharashtra during rabi 2019 to 2024. in Randomized Block Design with four checks In University Multilocation trials chickpea genotype AKGK-1801 was found superior by 15.20 % and 31.25% over the checks PKV Kabuli-2 and PKV Kabuli-4 respectively. In State Multilocation Varietal Trials proposed genotype AKGK-1801 has shown an increase yield. Maharashtra it was found to be superior over the existing checks by BDNG-798(1363kg/ha) (42.03%), PKV-Kabuli-4 1404kg/ha (37.79%), PDKV -Kabuli-2 1485 kg/ha (30.37%), Kripa 1531kg/ha (26.45%) and Virat 1763 kg/ha(9.81%) It having Early and synchronous maturity (105 days). Bold seeded (42g per 100 seeds) and Resistant to Moderately Resistant to *Fusarium wilt*. Therefore, it is considered as promising chickpea genotype for commercial cultivation to the farmers of Maharashtra, due to its special characters i.e. high yield potential with resistance to *Fusarium wilt* and pod borer, tall growth habit which is also suitable for mechanical harvesting.

EVALUATION OF *IN VIVO* ANTIOXIDANT ACTIVITY OF POLYHERBAL FORMULATION CONTAINING *TRIGONELLA FOENUM-GRÆCUM*, *MOMORDICA CHARANTIA*, *SYZYGIUM CUMINI* AND *CATHARANTHUS ROSEUS* IN STREPTOZOTOCIN INDUCED DIABETIC RATS

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Abstract

This study investigated the *in vivo* antioxidant activity of two polyherbal formulations (PHF-I and PHF-II) containing *Trigonella foenum-graecum*, *Momordica charantia*, *Syzygium cumini*, and *Catharanthus roseus*. These formulations leverage the synergistic effects of their active phytoconstituents to enhance therapeutic efficacy while minimizing adverse effects. All the selected medicinal plants are well known for their antidiabetic properties. Given the positive correlation between diabetes and oxidative stress, evaluating the antioxidant status of both the individual plants and the polyherbal formulations can provide insights into their antidiabetic potential. The formulations were orally administered to streptozotocin (STZ)-induced diabetic rats at doses of 200 and 400 mg/kg over 30 days. Antioxidant efficacy was assessed through biochemical analyses of key oxidative stress markers, including superoxide dismutase (SOD), catalase (CAT), and lipid peroxidation (LPO). The results demonstrated significant ($P < 0.005$) dose-dependent increases in SOD and CAT levels in the PHF-treated groups, particularly with PHF-I at 400 mg/kg (SOD: 2.9 ± 0.054 ; CAT: 2.4 ± 0.051), along with a substantial reduction in LPO levels (167.66 ± 0.614) compared to the diabetic control group. PHF-I exhibited superior antioxidative activity compared to PHF-II, suggesting its enhanced ability to reduce oxidative stress and mitigate diabetes-associated oxidative damage. Based on the study's findings, it can be suggested that polyherbal formulations have contributed to the reduction of oxidative stress, thereby ameliorating its severity as an herbal remedy. These formulations may potentially serve as effective alternatives to conventional antioxidant agents.

NUTRIENT-ENRICHED VEGETABLES: A SUSTAINABLE APPROACH TO MALNUTRITION

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Abstract

Vegetable bio fortification is a cutting-edge strategy that uses genetic modifications to increase the bioavailability of essential minerals and vitamins in vegetable crops. As human health heavily relies on a balanced intake of nutrients, the global



prevalence of malnutrition poses a significant challenge, with the root cause often being the consumption of nutritionally inadequate and unbalanced diets. Although there isn't a single approach that will completely eradicate malnutrition globally, bio fortification presents a viable and significant way to lessen its severity. Enhancing the nutritional profile of vegetables is a component of the procedure, which ensures that essential micronutrients like iron, zinc, and vitamin A are naturally incorporated into the diet. Bio fortification is an economical, environmentally friendly, and long-term approach to providing essential nutrients, in contrast with traditional food fortification techniques. This is particularly relevant for poor rural populations that have little access to fortified food products or supplements. This strategy supports crops that are not only more nutritious but also more adaptable to different environmental stresses, which is in line with the objectives of sustainable agriculture. Particularly in environments, vegetable bio fortification could be a key component of international initiatives to combat malnutrition, improve public health, and enhance quality of life. Through genetic improvement, bio fortified vegetables such as carrots with higher beta-carotene levels, iron-rich spinach, and zinc-enriched tomatoes have the potential to improve dietary quality significantly. Additionally, bio fortification is an easily implementable strategy that addresses hidden hunger by providing these small nutrients in a way that occurs naturally in staple food.

ASSESSING THE VARIABILITY OF ALLIUM GERMPLASM THROUGH THE USE OF MORPHOLOGICAL CHARACTERISTICS AND ILP MOLECULAR MARKERS

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Abstract

There are around 969 accepted species in the genus *Allium*; of these, onions (*Allium cepa* L.) are the most widely cultivated, used, and consumed, followed by garlic (*Allium sativum* L.). The north-east and western hilly regions of India exhibit a great diversity of *Allium* species and could serve as a source of genes to expand the genetic base of crops. Over 70 onion varieties/hybrids and 60 garlic varieties have been developed in India through research on *Allium* crop enhancement. However, because of high heterozygosity, inbreeding depression, and inadequate genetic care, the genetic production of those types has reached its potential level. Introgression breeding is necessary for further progress, particularly in the areas of disease resistance and abiotic stress tolerance. Before beginning distance crosses, it is necessary to comprehend the genetic diversity among related species of *Allium*.

In the current study, twelve morphological features were used to characterize onion varieties and sixteen additional *Allium* species. DNA-based characterization was performed using fifty polymorphism ILPs, or intron length polymorphic markers. Therefore, utilizing both molecular and morphological features, a total of 29 *Allium* germplasm samples have been examined for genetic diversity. *Allium* species have been divided into different categories based on the taxonomic classification and external characteristics of their leaves: hollow and flat leaves. These groups have then been further divided into subgroups based on characteristics such as flowering, tiller behavior, and leaf waxy cover. It was discovered that there were, on average, 3.4, 0.65, and 0.54 alleles per ILP locus, PIC, and heterozygosity, respectively.

SCREENING OF AM FUNGI FOR GROWTH PROMOTION OF BRINJAL UNDER CHALLENGE INOCULATION OF *SCLEROTIUM ROLFII*

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Abstract

Arbuscular mycorrhizal (AM) fungi play a crucial role in enhancing plant growth and resilience, especially under pathogen stress. In this study, forty native AM fungi isolates were screened with brinjal (*Solanum melongena*) as the host plant to assess their efficacy in promoting growth and colonization. The brinjal plants receiving ASAMF24 exhibited the maximum



spore production and AMF colonization (165 and 64.67%, respectively) followed by ASAMF10 (157 and 63.33%, respectively) and ASAMF18 (148 and 60.33%, respectively). The lowest spore production and AMF colonization were observed in the control plants (15 and 7%, respectively). The brinjal plants that were treated with native AMF showed an increased in shoot and root length. ASAMF10 also showed significantly higher dry weight (11.30 g) as compared to the control. ASAMF18 and ASAMF24 also showed a significant increase in total dry weight (11.21 and 11.22 g, respectively) as compared to other isolates. The findings from this study showed the potential of native AM fungi, particularly isolates ASAMF24, ASAMF10, and ASAMF18, as effective growth promoters under challenge inoculation of the pathogen.

GENETICS OF WHITE RUST RESISTANCE IN INDIAN MUSTARD (*BRASSICA JUNCEA*)

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Abstract

Inheritance of white rust resistance in P_1 , P_2 , F_1 , F_2 and backcross generation of five crosses of *B. juncea* revealed that one gene with complete dominance conferred resistance to white rust. A segregation ratio of 3 resistant: 1 susceptible in F_2 generations of these crosses further confirmed that white rust resistance is governed by a single dominant gene which can easily be transferred by backcrossing from a resistant to susceptible genotypes. Study was undertaken to know the inheritance of white rust resistance and allelic relationship of gene for white rust resistance in Indian mustard using diverse resistance sources viz., DRMR 2035, Bio-YSR, Heera, DRMRMJ35 (*Brassica juncea*) and GSL 1 (*Brassica napus*). Experiments were conducted during *rabi* 2023-24 at ICAR-Directorate of Rapeseed-Mustard Research, Bharatpur in RBD with three replications. Parents, F_1 s, F_2 s, and backcross (BC_1F_1 & BC_2F_1) of five crosses (DRMR 1165-40 x DRMR 2059; DRMR 1165-40 x DRMRMJ35; DRMR 150-35 x Heera; DRMR 150-35 x Heera; Varuna x BIO-YSR) and Parents, F_1 s and F_2 s of DRMRMJ35 x GSL-2 were evaluated in three environments created by using different date of sowing viz., 10 October 2023 (E_1), 10 November 2023 (E_2) and 25 November 2023 (E_3). The inheritance pattern of resistance genes in donors when crossed with four broadly cultivated, highly susceptible cultivars, DRMR 1165-40, DRMR 150-35, NRCDR 2 and Varuna showed the presence of a single dominant gene for white rust resistance. Cross between the resistant sources DRMRMJ35 (from *B. juncea*) and GSL 1 (from *B. napus*) segregated in 15:1 (resistant: susceptible) ratio in F_2 generation, indicating the involvement of two different genes governing white rust resistance in these sources are non allelic.

DEVELOPMENT OF AN EFFICIENT AND HIGHLY REPRODUCIBLE *IN VITRO* REGENERATION PROTOCOL FOR NIGER (*GUIZOTIA ABYSSINICA*)

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Abstract

Niger (*Guizotia abyssinica*) exhibits self-incompatibility, complicating the multiplication of pure inbred lines. To overcome this challenge, we have developed a highly reproducible and efficient *in vitro* regeneration protocol utilizing cotyledons and primary leaves as explants. This study employed Murashige and Skoog (MS) medium enriched with B5 vitamins (MSB) to initiate shoot formation. Systematic experimentation identified three optimal cytokinin combinations for inducing multiple shoots: 1 mg/l BAP, 1.5 mg/l BAP, and 1 mg/l 2-ip. Notably, primary leaves demonstrated superior shoot induction capability, yielding more than 15-20 shoots compared to cotyledons. Explants were sub-cultured at 15-20 day intervals to sustain multiple shoot generation. For shoot elongation, MSB medium supplemented with 1 mg/l GA3 and 0.2 g/l BAP was effective. Rooting of elongated shoots was successfully achieved using MSB medium with 1 mg/l IBA. The rooted plants were acclimatized successfully in a growth chamber, with regenerated plants flowering within 75 to 90 days post initial inoculation. This robust and efficient regeneration protocol enhances the reproducibility and repeatability of *in vitro* regeneration, presenting significant potential for agro-biotechnological applications. Furthermore, this methodology provides a foundational framework for genetic transformation and genome editing in Niger, thereby contributing to the conservation of desirable traits and the development of resilient crop varieties. This advancement not only supports the multiplication of elite genotypes but also paves the way for innovative approaches in crop improvement, aligning with the broader goals of enhancing agricultural productivity and sustainability.



STUDIES ON SEED BIOPRIMING USING *TRICHODERMA* G2 MUTANT FOR IMPROVED PLANT GROWTH PROMOTING ACTIVITY

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Abstract

Beneficial microorganisms are introduced directly to the soil and plant tissues or by seed inoculation, however soil application is recommended when there is a possibility of antagonistic or inhibitory microbes on the plant tissues. Insufficient microbe survival, difficulties in applying fungicides to the seeds, and exposure to heat and sunshine during subsequent seed storage in traditional inoculation procedures need the investigation of suitable and effective administration techniques. In some crops, seed priming—hydrating seeds to stimulate metabolism without germination and then drying them—increases germination, stand establishment, and stress tolerance. We therefore studied rhizosphere colonization and establishment of the bioagent in root following seed bio-priming. On biopriming of rice seeds using *Trichoderma* G2 mutant improvement is seen in germination percentage, no. of tillers, and root volume. It is speculated that through seed biopriming, G2 mutant has entered and stuck to seeds and become acclimated to the common circumstances. Biopriming is suggested as a potential way for applying helpful microorganisms to the seeds.

GENERATION OF INTERSPECIFIC POPULATION RESISTANT TO ANTHRACNOSE AND POWDERY MILDEW DISEASE IN CHILLI

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Abstract

Chilli (*Capsicum annuum* L.) is one of the most important commercial crops, grown in almost all parts of the world as well as in India. Anthracnose (*Colletotrichum capsici*) and powdery mildew (*Leveillula taurica*) are the major diseases of chilli. Chemical method of managing anthracnose and powdery mildew diseases is not sustainable and is also associated with health hazards and environmental pollution. Anthracnose causing 50 per cent yield losses and hence, major economic constraints for chilli production. Thus, one of the most economical and significant strategies to reduce crop losses is to cultivate resistant varieties, or hybrids. Host resistance breeding is the most effective method to control anthracnose in chilli. The large number of direct as well as reciprocal single crosses were attempted to enhance the cross compatibility between *C. annuum* and *C. baccatum*. It was found that the interspecific cross was compatible when male sterility-based hybrid UArchH42 (*C. annuum* x *C. annuum*) used as female and PBC80 (*C. baccatum*) as male. We developed large number of cross combinations (BC3F1) as well as selfed progenies using completely fertile and partial fertile plants. Resistance to anthracnose and powdery mildew was confirmed using infector fruit attached and infected plant attached methods respectively in BC2F1 generation. The population of BC2F1 generation was selfed to produced BC2F2 generation and individual plants were tested for anthracnose as well as powdery mildew disease resistant using molecular markers and natural epiphytic conduction respectively. We identified most of the population for powdery mildew resistant However, 36 plants were traced out as resistant to anthracnose.

BOOSTING RICE YIELD AND RESILIENCE: THE IMPACT OF MICROBIAL INOCULATION ON SOIL AND PLANT HEALTH

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Abstract

This study examines the impact of microbial inoculation with *Bacillus* sp. and *Pseudomonas* sp. on enhancing soil health, plant physiological responses, stress resilience, and overall productivity in rice cultivation. Conducted at two field sites, the research strategically integrated treatments that combined recommended doses of fertilizers (RDF) with microbial



inoculants and specific weed management practices to assess their effects on antioxidant enzyme activity, soil microbial activities, soil physico-chemical properties, nutrient acquisition and yield attributes. The results clearly showed that the treatment T5 incorporating RDF, microbial inoculants and weed management was observed with significantly superior results across all measured parameters compared to both the control and other treatments. T5-treated plants showed notably elevated antioxidant enzyme activities, indicating enhanced resilience to oxidative stress, and supported a rich diversity of beneficial soil microorganisms such as bacteria, fungi, actinomycetes, diazotrophs, and phosphate-solubilizing bacteria facilitating intensive nutrient cycling and heightened soil microbial activity. Soil enzyme activities crucial for nutrient mobilization, particularly dehydrogenase and phosphatase, were also substantially higher in T5, creating a biologically active and fertile soil environment. Improvements in soil physico-chemical properties were pronounced in T5 as well, with stabilized pH, elevated electrical conductivity, increased soil organic carbon, and greater availability of essential macronutrients (nitrogen, phosphorus, and potassium), all of which contribute to a rhizosphere that fosters robust plant growth. Consequently, T5-treated plants achieved the highest nutrient uptake in grain and straw and demonstrated superior performance in growth and yield metrics including greater plant height, panicle length, biomass accumulation, and grain yield. These findings underscore the potential of microbial inoculation, in combination with precise fertilization and weed management, as a sustainable and highly effective approach to support resilient, high-yield rice production systems.

NEW CONCEPT OF DEVELOPMENT OF LOW-CHOLESTEROL DAIRY PRODUCTS

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Abstract

Milk contains water, fat, protein, lactose, ash and vitamins. Milk is considered almost a complete food because of it providing essential nutrients for human nutrition. Milk contains high-quality of proteins, vitamins, and minerals to necessary growth and development. Fat play a significant role in the pricing system, nutrition, flavour, and physico- chemical properties of milk and milk products. It constitutes about 40% of the human diet and also providing essential fatty acids i.e linoleic and linoleinic acid and fat-soluble vitamins (A, D, E and K). Cholesterol-containing dairy and food products have damaged the market of fat-rich dairy products (butter and ghee) due to the increase in the incidence of coronary heart disease (CHD). CHD is one of the common causes of heart attack. Milk fat contains about 0.25 to 0.40% cholesterol. Cholesterol is in soluble in water, sparingly soluble in alcohol, and soluble in ether, chloroform, alcohol and vegetable oils. Cholesterol comes in body from endogenous synthesis as well as dietary intake. The effect of dietary cholesterol on plasma cholesterol levels varies among individuals, with some being hyper-absorbers or hyper-responders. Fat, including cholesterol, absorbed from the diet, is insoluble in the aqueous medium of the blood. The coronary heart disease (CHD) is the common cause of heart attack is one of the causes of death in developed and developing countries. In milk, about 80% of the cholesterol is related with the milk fat globule (MFG) and 80-90% of the total cholesterol is present in the milk in the free form. The average cholesterol content in cow and buffalo milk is 2.8 mg/g and 1.9 mg/g fat respectively. Cheese contains 52.3 to 76.5 (Average value 69.3) mg of cholesterol/100 g and 198 to 297 (Ave 273) mg/ fat in cheese. There are many factors affecting the cholesterol in milk and dairy products such as effect of species and breeds, effect of seasons, effect of stage of lactation, effect of Heat etc. Various methods like physical, chemical and biological have been developed for reducing cholesterol in milk and dairy products such as molecular distillation, team stripping, solvent extraction, reaction with cyclic anhydride, enzymatic method and adsorption method.

HARNESSING BIOTECHNOLOGY TO COMBAT ARSENIC TOXICITY IN RICE

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Abstract

Arsenic toxicity is a critical concern for global agriculture, food safety, and human health. Arsenic toxicity is a critical concern for global agriculture, food safety, and human health. Arsenic poisoning adversely affects plants, soil, water, and human health, posing a significant threat to sustainable agriculture. Globally, around 300 million people are exposed to



arsenic-contaminated groundwater. Prolonged exposure is associated with severe health issues, including cancer, developmental disorders, and skin lesions. The widespread use of arsenic-containing pesticides, fertilizers, and industrial processes leads to soil contamination, reducing fertility and productivity. Arsenic contamination in rice exists mainly in two forms, inorganic and organic form. While inorganic arsenic is highly toxic, dimethylarsinic acid (DMA), an organic arsenic species, is considered relatively less harmful. Studies have suggested the use of biotechnological approaches to reduce arsenic levels and promote safer rice production.

EFFECT OF INTERCROPPING ON GROWTH PARAMETERS AND SOIL PROPERTIES OF ASSAM LEMON (*CITRUS LIMON*)

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Abstract

An experiment was conducted at the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat, Assam on “Effect of Intercropping on growth parameters and soil properties of Assam lemon (*Citrus limon*)” with an objective to evaluate the effect of intercropping on the growth parameters and soil properties of Assam Lemon. The experiment was designed with Split plot with 4 main plots viz., M₁=(sole Assam Lemon), M₂ = (Assam Lemon + Broccoli), M₃ =(Assam Lemon + French Bean) and M₄ =(Assam Lemon + Spinach Beet) and 3 sub plots e.g. S₁ =(Cowpea), S₂ =(Amaranthus) and S₃=(Okra) with 5 replications. Assam Lemon intercropped with Broccoli (M₂) during the winter season showed highest growth parameters like plant height, girth, N-S plant spread and maximum plant canopy area (71.31 cm, 2.06 cm, 70.76 cm and 4270.29 cm²) respectively. However during summer intercropping with Cowpea (S₁) had the highest plant height (67.56 cm), girth (2.01 cm), N-S plant spread (67.64 cm) and maximum plant canopy area (4075.26 cm²) respectively. The study on soil parameters revealed that Assam Lemon intercropped with Broccoli (M₂) had the highest soil pH (4.66), Soil Organic Carbon (0.58%), N (176.52 kg ha⁻¹), P (9.86 kg ha⁻¹) and K (126.90 kg ha⁻¹) respectively during winter. Similarly during summer intercropping with Cowpea (S₁) had the highest soil pH (4.60), Soil Organic Carbon (0.57%), N (174.02 kg ha⁻¹), P (9.79 kg ha⁻¹) and K (125.76 kg ha⁻¹) respectively. Sole Assam Lemon showed the lowest soil parameters viz., pH (4.66), Soil Organic Carbon (0.58%), N (176.52 kg ha⁻¹), P (9.86 kg ha⁻¹) and K (126.90 kg ha⁻¹) respectively. From the study it was noted that intercropping improves the growth parameters of Assam Lemon and also improves the soil properties.

COTTON INSECT PEST DYNAMICS IN VIRUDHUNAGAR DISTRICT OF TAMIL NADU

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Abstract

Roving survey was conducted to know the pest situation of cotton in Virudhunagar district. During September 2023 thrips incidence to the tune of 22.80% was observed in vegetative stage at Kadaneri village. In T.Kallupatti 16.19% thrips incidence was observed. During October 2023 in vegetative stage leaf hopper incidence to the tune of 3.2 /3 leaves was observed in Sithamanayakanpatti and flowering stage in Pillaiyarkulam. During square formation stage 1.0 leafhopper /3 leaves was observed in Padikasuvaitanpatti village. During November 2023, leaf hopper was ranged in between 1.0 – 5.8 leaf hoppers/3 leaves. Maximum of 5.8 leaf hoppers/3leaves were observed in Periyakulathupatti followed by Kallipatti(4.6). In Nandhikundu 0.8 whitefly/3 leaves was observed. Maximum of 16.0% stem weevil incidence was observed in Periyakulathupatti followed by Kallipatti(10.0%). During December 2023, maximum of 6.0 hoppers were observed in Melarajakularaman (0.2/3 leaves) followed by S.Ramalingapuram (3.6/3 leaves). Malli and Athikulam 0.4 whitefly/3 leaves was observed and in Melarajakularaman 16% stem weevil incidence was observed.



ELECTROSTATIC FIELD TREATMENT : AN INNOVATIVE APPROACH FOR SEED QUALITY ENHANCEMENT OF LOW VIGOUR SEEDS IN TOMATO

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Abstract

With the global population expected to reach 9.8 billion by 2050, the demand for food production, including essential vegetable crops like tomatoes (*Lycopersicon esculentum*), is rising. In India alone, tomatoes are grown on roughly 880,000 hectares, producing 18 million tonnes annually. Enhancing seed quality is critical to sustaining productivity, yet traditional enhancement methods like physical, chemical, and biological—have limitations. Biological methods are complex and time-intensive, while chemical treatments can leave harmful residues. This highlights the need for a simple, eco-friendly, and effective alternative. This study explores the use of electrostatic field (ESF) treatment as an innovative physical method to enhance seed quality, focusing on low-vigour tomato seeds. The experiment was conducted at the Department of Seed Science and Technology, UAS, Dharwad, India, the experiment employed a factorial completely randomized design (CRD) with three ESF power levels (3 kV, 4 kV, and 5 kV) and three treatment durations (60 sec, 90 sec, and 120 sec), each replicated thrice for which several key seed quality parameters were assessed. Significant increase in germination percentage (89.24%), speed of germination (9.35), root and shoot length (6.63cm and 6.25cm), seedling dry weight (23.83mg/10 seedlings), seedling vigour index II (1937) were recorded as compared to control which registered lower seed germination percentage (70.12%), speed of germination (6.60), root and shoot length (4.02cm and 3.98cm), seedling dry weight (21.50 mg/10 seedlings), seedling vigour index-II (1516). Further, seed coat permeability was also strengthened with P₃D₂ treatment exhibiting lesser electric conductivity value (0.32 dSm⁻¹) than untreated control (0.81 dSm⁻¹). Additionally, biochemical parameters such as superoxide dismutase, peroxidase, catalase activity, and proline content were also evaluated. Preliminary results suggest that ESF treatment could induce biochemical changes that improve seed quality, offering a promising, sustainable approach to seed treatment. This technique could enhance germination and vigour in tomato seeds, contributing to higher productivity and supporting food security efforts.

IMPACT OF HEAVY METALS SPIKED WASTEWATER IRRIGATION ON METAL PHYTOREMEDIATION, SOIL HEALTH, AND PRODUCTIVITY OF GAILLARDIA (*GAILLARDIA PULCHELLA* FOUQ.)

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Abstract

The present study was conducted to investigate the impact of heavy metal-spiked wastewater irrigation in gaillardia in water technology centre at ICAR-IARI New Delhi, during 2022-23. This study investigated the impact of heavy metal-spiked wastewater irrigation on Gaillardia, a flowering plant with potential for phytoremediation. The objectives were to assess the effects of heavy metal-spiked wastewater irrigation on plant growth, soil health, and heavy metal accumulation in plants and soil. Seven treatments were used in this study: T1: Pure groundwater irrigation without heavy metals; T2: Wastewater irrigation without heavy metals; T3: Wastewater irrigation spiked with Cd (0.005 ppm), Cr (0.05 ppm), Ni (0.1 ppm), and Pb (2.5 ppm); T4: Wastewater irrigation spiked with Cd (0.01 ppm), Cr (0.1 ppm), Ni (0.2 ppm), and Pb (5.0 ppm); T5: Wastewater irrigation spiked with Cd (0.1 ppm), Cr (1 ppm), Ni (2 ppm), and Pb (10 ppm); T6: Wastewater irrigation spiked with Cd (0.25 ppm), Cr (2.5 ppm), Ni (5 ppm), and Pb (30 ppm); T7: Wastewater irrigation spiked with Cd (0.5 ppm), Cr (5.0 ppm), Ni (10 ppm), and Pb (50 ppm) each treatment was replicated three times in a completely randomized design. Gaillardia plants were irrigated with the respective treatments for a period of 2.5 months. The results showed that wastewater irrigation enhanced the productivity of Gaillardia. The treatments involving heavy metal-spiked wastewater demonstrated even higher flower yields. However, there was no noticeable impact of heavy metal-irrigated wastewater on the keeping quality of Gaillardia flowers. The soil analysis showed that heavy metal-spiked wastewater irrigation resulted in significantly higher concentrations of heavy metals in the soil, with the highest concentrations observed in Treatment T-7. The heavy metal concentrations in the plant parts varied depending on the element and the treatment. Nickel (Ni) concentrations ranged from 0.94 to 6.11 mg/kg in



flowers, 31.17 to 99.90 mg/kg in shoots, and 16.80 to 81.75 mg/kg in roots, increasing from T1 to T7. Chromium (Cr) concentrations varied from 0.81 to 4.44 mg/kg in flowers, 3.41 to 17.10 mg/kg in shoots, and 1.98 to 9.94 mg/kg in roots, mirroring the Ni trend with increasing values. Cadmium (Cd) levels were relatively low, ranging from 0.00 to 0.11 mg/kg in flowers, 0.00 to 0.17 mg/kg in shoots, and 0.00 to 0.11 mg/kg in roots, showing slight variations among treatments. Lead (Pb) concentrations ranged from 0.65 to 4.07 mg/kg in flowers, 10.60 to 28.70 mg/kg in shoots, and 8.64 to 22.30 mg/kg in roots, also increasing from T1 to T7 in all plant parts. The findings of this study suggest that the use of heavy metals spiked wastewater may have a detrimental effect on soil health. However, the selected crop, *Gaillardia pulchella* Foug., exhibits strong phytoremediation potential. This means that *Gaillardia* can withstand irrigation with heavy metals spiked wastewater without significantly compromising its productivity. As a result, *Gaillardia* could be a promising choice for phytoremediation purposes in such contaminated environments.

GENETIC DIVERSITY ANALYSIS IN INDIAN POTATO GERMPLASM COLLECTION THROUGH MORPHOLOGICAL PARAMETERS, MOLECULAR MARKERS, NUTRITIONAL AND RESISTANCE TRAITS

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Abstract

Potato is the major staple, non-grain food crop cultivated worldwide for its tubers and occupies third rank in terms of human consumption. Potato has immense reservoir of genetic resources that has the potential genes for introgression in improvement program including quality enhancement as well as resistance. Morphological characterization is one of the fundamental methods for exploring the relations between genotypes, which makes genotypic characterization easier. Molecular markers-based characterization esp Simple sequence repeats (SSRs) co-dominant, locus-specific markers are desirable method for genetic diversity analysis and fingerprinting. Biotic stress viz., Late blight and Potato Cyst Nematode/PCN are the main yield limiting factor amongst the diseases of potato in India and across the globe. Per capita rising potato consumption necessitates catering the nutritional enhancement. In the present study, a group of specific potato genotypes, indigenous ones, collected from different parts of the country along with checks were evaluated morphologically (51 DUS traits,) SSR Markers, nutritional parameters, resistance to late blight and PCN under natural epiphytotic field conditions and in laboratory conditions. Some of the genotypes (11 nos) were early maturing (<80 days) an ideal trait for introgression with yield ranged from 73-475 q/ha. Kanpuria Safed, JG-1, Rangpuria and Desi Aloo showed resistance to late blight both under laboratory and field conditions. In case of PCN, Garlentic, Jeevan Jyoti and JG-1 have combined resistance (0 female/root ball) over the years to both the species. The nutrient content ie ascorbic acid, carotenoids anthocyanins and phenols were at medium levels. Preponderance of the genotypes with medium to high pollen viability with advantageous tuber and yield traits excel in their usage as parental lines in potato improvement program.

EFFECT OF DIFFERENT FERTIGATION LEVELS ON GROWTH, YIELD AND ECONOMICS OF MAIZE (*ZEAMAYS L.*) IN SOUTH EASTERN ZONE VI OF JHARKHAND

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Abstract

A field experiment was conducted at Zonal Research Station, Darisai, East Singhbhum, during kharif season of 2019, 2020 and 2021 to find out the optimum fertigation level and economics of maize. The experiment consisted of four treatments viz; T₁- 100% RDF through fertigation, T₂- 75% RDF through fertigation, T₃- 50% RDF through fertigation and T₄-100 % RDF through soil application laid out in randomized block design with five replications. The experiment revealed that higher grain yield (48.95 q/ha) was recorded in treatment T₂- 75% RDF through fertigation with maximum plant height (212.03 cm), length of cob (19.51 cm), girth of cob (14.90), number of row/cob (15.09) and stalk yield (132.50 q/ha) and was significantly superior over rest treatment. The lowest grain yield was recorded with 100 % RDF through soil application (33.31 q/ha). The



maximum fertilizer use efficiency of 34.03 kg/kg of nutrient was recorded at 50% RDF through fertigation. Among different fertigation levels, fertigation through 75 per cent recommended dose of fertilizers resulted in higher net income (Rs 64976/ha) and benefit cost ratio (1.97) and minimum net income (Rs 34554/ha) and benefit cost ratio (1.08) was observed in 100 % RDF through soil application.

ASSESSING THE IMPACT OF NITROGEN FERTILIZER APPLICATION ON GRAIN YIELD AND ITS PROTEIN CONTENT IN DIFFERENT WHEAT GENOTYPES

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Abstract

Wheat is one of the most significant cereal crops worldwide and a remarkable source of protein and calories for human consumption. More than 35% of people on the planet use wheat as a staple food which significantly boosts food security and serves as a major source of vital nutrients like proteins, carbs, and micronutrients. Due to dietary changes and population expansion, the demand for wheat has been rising continuously, putting significant pressure on agricultural systems to enhance productivity, particularly in areas with a shortage of arable land. Soil fertility, water availability, and nutrient management especially nitrogen are some of the environmental and agronomic aspects that affect wheat farming. Nitrogen is a crucial component for wheat cultivation, affecting both grain quality, yield and protein concentration. Wheat requires nitrogen as a nutrient that has a significant impact on growth, development and the quality of the grain. It is essential for a number of physiological functions, such as the synthesis of proteins, amino acids, and chlorophyll, which collectively affect the crop's quality and yield. Wheat's nitrogen use efficiency (NUE) determines grain quality and yield potential, is an integral aspect of sustainable crop production. While minimizing the adverse consequences of excessive nitrogen applications on the environment, efficient nitrogen utilization can enhance grain output. Grain yield and protein content are two common metrics used to assess the NUE in wheat. Due to enhanced biomass production, tiller growth, and grain filling, higher nitrogen inputs typically result in higher grain yields. In the present study, 26 diverse wheat cultivars has been taken and studied for nitrogen use efficiency by giving different doses of nitrogen. Wheat cultivars PxW566-28, LIRA/TAN, NP 710, PBW 502, HD 2781, PxCim49-265, PxWat34-33, PxWat292-60, PxWat264-90 are giving the better results for nitrogen use efficiency.

INFLUENCE OF ORGANIC MANURE AND BIOFERTILIZER ON GROWTH & YIELD OF SPROUTING BROCCOLI (*BRASSICA OLERACEA* VAR *ITALICA*)

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Abstract

The field experiment was conducted during the Rabi season of 2020-2021 at the Department of Horticulture Research Station, Sikkim University, to evaluate the impact of organic manure and its combination with biofertilizers on the growth and yield parameters of sprouting broccoli (variety: Gennext Crop Science Pvt. Ltd). The study carried out by Randomized Block Design with thirteen treatments and three replications. The results revealed that all treatments significantly performed well then control in terms of growth parameters like plant height, number of leaves, leaf area, plant spread, and early curd initiation. As among the treatments, T9 (vermicompost 100%, 5 t/ha, combined with azotobacter at 2.5 ml/liter) demonstrated the best performance in enhancing growth parameters. On the other hand, yield parameters such as average curd weight and total yield per plot were found to be highest in T4 (a combination of vermicompost 75%, 5 t/ha, and FYM 25%, 10 t/ha). Overall, the



study observed that integrating vermicompost with azotobacter effectively enhanced growth parameters, while the combination of vermicompost and FYM proved most beneficial for maximizing yield. This highlights the potential of using organic manures and biofertilizers to sustainably improve the performance of sprouting broccoli, ensuring better growth and higher yields. Such practices can serve as a viable alternative for promoting eco-friendly and sustainable horticulture practices in diverse agro climatic regions.

AGRI-TOURISM—A MEANS OF CREATING RURAL HOSPITALITY INDUSTRY IN RAJASTHAN

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Abstract

Tourism, as defined by the World Tourism Organization (WTO), involves activities of individuals traveling and staying outside their usual environment for leisure, business, and other purposes. Rajasthan has been a significant player in India's tourism industry, contributing 15% to the state's GDP and providing employment to around 10 million people. Despite this, the potential of agri-tourism, which is closely linked to rural tourism, remains largely untapped. Agri-tourism involves activities that draw visitors to farms, allowing them to participate in farm operations and appreciate food production. It is growing at a 20% annual rate and aligns with the goal of Aatmanirbhar Bharat by promoting sustainable practices and rural livelihoods. Rajasthan, with its diverse climates, rich cultural heritage, and significant agricultural output, has great potential for agri-tourism.

Rajasthan is primarily an agrarian state with diverse climates that promote the cultivation of various crops. The state is also known for its animal wealth, making it an important livestock state. The unique cultural and historical heritage of Rajasthan, including its forts, urban settlements, and religious centers, adds to its tourism appeal. Additionally, Rajasthan is home to important wildlife spots like Ranthambore and Sariska. Despite this potential, agri-tourism in Rajasthan faces several challenges. The primary issues include a lack of awareness about agri-tourism, limited government support, and insufficient manpower to undertake such activities. To improve agri-tourism, several recommendations have been suggested, including developing rural infrastructure, promoting agri-tourism through mass media, providing training and capacity building, and forming strong alliances between various stakeholders.

Efforts to boost agri-tourism are underway, but more studies and concrete actions are needed to make it a mainstream tourism activity. The government has created a policy framework and provided financial assistance to boost agri-tourism, but these efforts are still minimal and require more concerted efforts. Additionally, there is a need for trained human resources to handle and provide consultation to farmers in tourism activities. Agricultural universities and colleges should take the lead in framing and training manpower for these tasks. With such efforts, agri-tourism has the potential to become a mainstream tourism activity, providing gainful employment to individuals and boosting the state's earnings from tourism-related activities. This, in turn, can change the rural outlook and contribute significantly to the overall development of Rajasthan.

INFLUENCE OF ALTITUDINAL GRADIENT ON THE ANTIOXIDANT ACTIVITY IN *POTENTILLA FRUTICOSA* AND *REINWARDTIA INDICA* FROM PIR PANJAL RANGE OF JAMMU & KASHMIR INDIA

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Abstract

Altitude may influence types and contents of active substances. This study investigated the influence of altitudinal gradient on the active substance contents and antioxidant activity of *Potentilla fruticosa* *Reinwardtia indica* from three different region of Pir Panjal range of Jammu region. To evaluate antioxidant activity from the leaf extracts of *Potentilla fruticosa* and *Reinwardtia indica* by FRAP and DPPH assay. Result shows that as we go from 930m, to 1843m asl. There is increase in antioxidant activity. Plants and organisms living at higher altitudes often adapt to cope with oxidative stress. This includes up regulating enzymes like superoxide dismutase (SOD), catalase, and glutathione peroxidase, which are part of the antioxidant



defense system. Thus, the findings of this research provide valuable information on how a narrow range of elevational gradient affects the antioxidant activity of the above medicinal plants.

ASSESSMENT OF PLANT BIO STIMULANTS AND BIO INOCULANTS ON THE GROWTH AND YIELD OF FODDER MAIZE IN ORGANIC CONDITIONS

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Abstract

Organic farming practices help produce organic milk and promote sustainable agriculture. However, there is limited research regarding the application of plant bio stimulants, bio inoculants and farmyard manure (FYM) in the cultivation of fodder crops under organic conditions. Therefore, we undertook this study to investigate the synergistic effects of different plant bio stimulants and bio inoculants on the growth and yield of fodder maize. A field experiment was carried out in *kharif* season 2023 at the Research Farm, Agronomy Section, ICAR-NDRI, Karnal, Haryana in Randomized Block Design (RBD) with six treatments replicated six times. Treatments include; T₁-Absolute control, T₂-100 RDN (Recommended Dose of Nitrogen) through FYM, T₃- PGPR+ 75% RDN through FYM+ 3 sprays of *Panchagavya* T₄- PGPR+75% RDN through FYM+ 3 sprays of Seaweed extract T₅-Beejamrit+75% RDN through FYM+3 sprays of *Panchagavya* T₆- Beejamrit + 75% RDN through FYM+ 3 sprays of Seaweed extract. The result revealed that the application of plant biostimulants significantly increases the growth attributes compared to the absolute control treatment. The highest plant height and number of leaves plant⁻¹ was recorded in T₃- (PGPR+ 75% RDN through FYM+ 3 sprays of *Panchagavya*) and lowest under T₁- (Absolute control). T₃ recorded 20% higher plant height at harvest and 25% more number of leaves at harvest than treatment T₁ (Absolute control) which eventually indicates the higher nutrient uptake by the crop. Similarly, the highest green fodder yield was recorded in T₃ treatment which further ensures overall higher fodder yield, due to treatment with PGPR and *Panchagavya*. It may conclude that the combined application of PGPR and *Panchagavya* with FYM is quite promising for improving the growth and yield attributes of fodder maize under organic conditions for producing organic milk.

CLIMATE CHANGE AND FOOD SECURITY

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Abstract

The UN Committee on World Food Security defines the concept as : Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life. It is one of the humanity's most serious threats, putting at risk the functioning of the natural systems that sustain human health. Since last two three decades Climate change became a major serious concern as it has both direct and indirect impacts on food security and biodiversity. Food security is a measure of people's access to safe and nutritional food. It depends on several factors, including the availability and affordability of food. In the Anthropocene, human activities have significantly altered the Earth through global warming, habitat loss and changes to the atmosphere. Large changes in biodiversity are expected to occur if climate change continues at its current pace. Adverse effects include changes in species habitats and compositions, and consequently changes in ecosystem functioning. The UN Convention on Biological Diversity defines biodiversity as the diversity and variability among living organisms within the terrestrial, marine and other aquatic ecosystems they are part of. According to the World Wildlife Fund, there has been an average 68% fall in the monitored populations of mammals, birds, amphibians, reptiles and fish since 1970... Nevertheless, the impact of climate change on biodiversity and food security has been recognized, little is explored compared to the magnitude of the problem globally. Therefore, this matter of concern needs to be looked out and judicious measures need to be applied to combat it so as to balance climate change, biodiversity, and food security. Climate change is happening due to natural factors and human activities. It expressively alters biodiversity, agricultural production, and food security. Mainly, narrowly adapted and endemic species are under extinction. Which needs to be addressed.



INCREASING PRODUCTIVITY AND PROFITABILITY OF SOYBEAN THROUGH DIFFERENT AGRO CHEMICALS UNDER RAINFED CONDITIONS IN MAHARASHTRA REGION

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Abstract

The introduction of soybeans has increased cropping intensity, which has raised profitability per unit of land area. Soybean will persist as a significant rainfed oilseed crop in India. In Maharashtra, the economic exploitation of soybeans dates back almost forty years. The crop has demonstrated unparalleled expansion in both area and productivity throughout this time. In central and peninsular India's rainfed agro-ecosystem, soybeans have become a significant rainy season crop. This extraordinary growth has been the product of numerous bred kinds. Based on modelling studies and on-farm demonstrations, the rainfed potential of soybean in India with current varieties is approximately 2.1 t/ha, compared with a national productivity average of only 1.2 t/ha. As a result, there are significant yield gaps between the potential and actual yields that farmers actually collect. The production of soybeans might double if this yield difference closes. By applying novel research techniques and taking advantage of recent developments in biology, it will be feasible to further increase the production of soybean grain and the quality of soybean oil. The National Agricultural Research System has so far been effective in satisfying the agricultural and industrial communities' needs for research.

JUDICIOUS USE OF ARTIFICIAL INTELLIGENCE (AI) IN INDIAN AGRICULTURE

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Abstract

Presently the Indian agricultural is facing barriers like declining soil fertility, labour shortages, climate change and limited land holdings in achieving the targeted production. Twenty first century is the era of Artificial intelligence (AI). It is predicted that global population by 2050, would be 10 billion which would be creating high pressure on agricultural sector to increase yields and productivity. Artificial intelligence (AI) could certainly play a crucial role in solving a global food problem. AI enables farmers to minimise crop loss and prepare for unfavourable weather events. It also enables farmers to know well in advance about pricing and demand changes in the market, and thus to choose their best times to sow, harvest, and sell produce in order to maximize profits. Precision farming methods have been greatly improved by AI, allowing farmers to maximise crop yield and reduce resource wastage. AI also enables to gather data on crop health, soil quality, and moisture levels in real time using satellite imaging, drones, and sophisticated sensors. Farmers can utilise this data to improve their decisions about pest control, fertilisation and irrigation, which will result in a more focused and effective use of resources. By using less water, herbicides and fertiliser, this precision method not only increases crop yields but also supports sustainable farming practices. AI has developed a new programme called Plantix to address this problem. Farmers may forecast market trends and comprehend consumer preferences with the use of AI-powered market analysis tools. Disease and pests are the major threats to the economy, environment, and food security. Early detection of the disease play a crucial role in effective management of crop diseases. AI-based picture recognition systems enable to identify specific plant diseases and accordingly farmers can take effective control measures on their fields. Artificial intelligence (AI) algorithms enable to know about price trends and swings in demand.

USE OF BIOTECHNOLOGY FOR TRANSGENIC COTTON IMPROVEMENT IN AGRICULTURE

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Abstract

Transgenic cotton has been developed by introgressing one or more genes by either the use of genetic engineering or by



advanced breeding programs. However, to counteract resistance against other insects and pests, these resistant varieties still need to be improved by introducing new genes. Farmers have effectively made use of Bollgard I and Bollgard II during their season. Transgenic cotton is one of the most valuable crops developed through transgenic strategies so far. Transgenic technologies are an important component of plant breeding pipelines today. Nowadays, any agricultural improvement strategy developed to meet the increasing challenges brought about by the growing population must take biotechnological advancements into account. In the last twenty years, biotechnology has presented enormous opportunities, chiefly in the form of new transgenic plants to fight biotic and abiotic stresses. The researcher has always faced challenges in the development and sustenance of cotton. Therefore, the use of gene editing technology, RNA interference, antisense technology, etc. has now become popular in modifying and improving its phenotypic and genotypic traits. The result will additionally make it quicker for researchers to examine the desired feature, but it will also enable them to assist farmers who encounter difficulties with seasonal cultivation.

USE OF ARTIFICIAL INTELLIGENCE TO ENHANCE AGRICULTURAL PRODUCTIVITY

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Abstract

The main one among them that is currently receiving attention on a global scale is its scientific improvement. The demand for food security is rising dramatically due to population growth across the globe. Farmers were not capable of meeting these requirements via traditional methods. Agriculture constitutes a key in the field that earns income. As a result, more effectively automated strategies were put forward. These ground-breaking methods provided food for the entire world while also providing a means of subsistence for billions of people. Thus, artificial intelligence (AI)-based technologies have proven successful in decreasing resource consumption, enhancing reliability and honesty, while concurrently boosting agricultural supply and grade and eradicating food wastage. AI is helping the modern agricultural framework to progress to another level. In the real-time agricultural era, selecting, interpreting, and marketing have all improved with artificial intelligence. productivity, crop performance, and a host of other elements. Socioeconomic principles will improve when artificial intelligence is used in agriculture, which might persuade growers to support and believe in it. The introduction of these platforms was aided by the development of an array of highly technologically advanced devices that are effective in determining a wide range of crucial elements, including the identification of weeds.

ENSURING FOOD SAFETY THROUGH USE OF AGRICULTURE PLANT GENETIC ENGINEERING ADVANCEMENT TECHNOLOGY

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Abstract

The field of plant genetic engineering can help to improve such feasible objectives through the emergence of better-performing plants with enhanced resistance to various biotic and abiotic stresses such as herbicide tolerance and insect resistance in soybean and maize that are required due to the rising population and developing climatic challenges. A highly relevant issue of the twenty-first century is the problem of food security. The vehicles of genetic modification in crops can be a solution by using a technique known as gene stacking. The purpose of this method is to combine two or more genetically engineered characters or traits in crops with the use of plant breeding. The process of breeding resistance will be made much simpler by gene-stacking, which can also be customized for specific local pathogen populations. Global food security and the sustainability of agriculture could be considerably strengthened by breeding for permanent resistance to pests and diseases. Moreover, the other way to create genetically modified plants is to modify already-existing engineered plants to add one or more new transgenes or one way is to use a vector holding multiple transgenes to modify a non-genetically modified plant. Furthermore, this can help farmers to protect their crops from the effects of global warming and retain their output.



MITIGATING CLIMATE CHANGE BY USE OF MODERN TECHNOLOGIES IN AGRICULTURE

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Dr. Panabrao Deshmukh Krishi Vidyapeeth, Akola (MS)

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Abstract

Most new technologies alter how agricultural inputs are used, frequently in ways that affect how the weather affects output and the way production affects greenhouse gas emissions. Numerous techniques have been used to reduce the impact of hunger and provide nourishing food to the expanding population to address the issue of food supply. The agricultural sector already encounters huge obstacles which are made worse by climate change. This is particularly apparent in developing nations. The population explosion era has resulted in an all-time high demand for food supplies. Amidst worldwide warming, agricultural innovations will become even more extremely important compared to what they currently constitute. By using innovative techniques like plant genetic engineering, molecular breeding, speed breeding, artificial intelligence, CRISPR-CAS technology, OMICS technology, and others, the burgeoning field of agricultural biotechnology is now helping crops to address these problems. These cutting-edge technologies will strengthen the agricultural industry's supply chain by delivering high-quality, timely crop productivity, and resistance varieties in the market. Furthermore, by giving farmers access to superior crop varieties, their problems will be relieved and their means of subsistence will be. These techniques can help to reduce the effects of global warming on crops by enhancing their characteristics to withstand harsh conditions.

STUDIES ON INOCULATION OF *RHIZOBIUM* FOR ENHANCING THE YIELD AND YIELD ATTRIBUTES OF PIGEONPEA

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Abstract

The study carried out in the field to know the performance of various *Rhizobium* on grain yield and yield attributes of Pigeonpea (TARA). The *Rhizobium* were procured from Pulses Research Unit of various regions of the India during *kharif* 2023-24. The experiment comprising of ten treatments including RDF and uninoculated control. The experiment was laid out in randomized block design with three replications. The carrier-based cultures of Pigeonpea *Rhizobium* were inoculated @ 25 g/kg seed. The seed inoculation with Pigeonpea *Rhizobium* (PKVPR-16) isolate resulted in higher grain yield (977 kg/ha), maximum nodulation (23.20 nodules /plant) nodule dry weight (91.07 mg/plant) and plant dry weight (5.19g/plant) among all the treatments of the experiment.

DYNAMICS OF PHYSIOLOGICAL TRAITS IN RESPONSE TO HEAT STRESS IN CHICKPEA (*CICER ARIETINUM* L.)

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Abstract

Chickpea, one of the most important pulse crops, is grown across many countries including India. Chickpea is nutritionally significant in human diets due to its high protein content and superior protein digestibility relative to many other pulses. However, the crop often suffers due to various stresses including drought and heat. Off late due to changing climatic conditions and seasonal variations, the crop faces heat stress especially during critical crop growth stages leading to significant yield loss. The present study aiming at identifying the heat tolerant chickpea genotypes, involved forty genotypes which were evaluated under timely sown (normal) and late sown (heat stress) conditions. The differential response of important physiological traits viz., per cent membrane leakage, total chlorophyll content and canopy temperature depression were recorded under these two heat regimes to understand the trait dynamics. The per cent membrane leakage under timely



sown condition ranged from 22.83 to 46.61 with a mean of 35.01, while under late sown condition, its range was 31.75 to 69.54 with a mean of 47.00. The mean membrane susceptible index (MSI) was 81.60, ICCV 191216 (93.39) had the highest MSI followed by ICCX-060157-F3-BP-P24-BP-BP-P5-BP (93.11). The mean total chlorophyll content under timely sown condition was 2.31 mgg⁻¹ with a range of 0.80 mgg⁻¹ to 3.89 mgg⁻¹ whereas, under late sown condition, total chlorophyll content varied from 0.79 mgg⁻¹ to 3.33 mgg⁻¹ with the mean of 1.70 mgg⁻¹. Chlorophyll stability index (CSI) had the mean of 75.68 with genotype ICCV 191253 (99.82) recording highest CSI followed by ICCX-060157-F3-BP-P24-BP-BP-P5-BP (99.72) while ICCX 120046-B-B-B-B-49-B (36.09) showed the lowest. The average canopy temperature depression (CTD) was observed to be 5.16 °C under normal condition, varying between 2.70 and 7.50 °C, while, under heat stress condition, it had an average of 2.74 ranging between 0.65 and 4.34 °C. The highest CTD of 7.10 was noticed in ICCV191216 while the lowest was in ICCX-100106-F4-P11-BP-BP (3.30) under normal condition. The genotype, ICCX-060157-F3-BP-P24-BP-BP-P5-BP was best with 4.10 CTD and SA 1 was poor (1.05) under heat stress condition. The difference across regimes was minimum in ICCX-060157-F3-BP-P24-BP-BP-P13-BP (0.20) and maximum in ICCX 120044-B-B-B-B-28-B (5.83). The current study isolated around nine heat tolerant genotypes which will be utilised in stress resistance breeding along with testing under yield evaluation trials to identify the cultivar with desired traits.

JUDICIOUS USE OF ARTIFICIAL INTELLIGENCE (AI) IN INDIAN AGRICULTURE

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Abstract

Presently the Indian agricultural is facing barriers like declining soil fertility, labour shortages, climate change and limited land holdings in achieving the targeted production. Twenty first century is the era of Artificial intelligence(AI).It is predicted that global population by 2050, would be 10 billion which would be creating high pressure on agricultural sector to increase yields and productivity. Artificial intelligence(AI) could certainly play a crucial role in solving a global food problem. AI enables farmers to minimise crop loss and prepare for unfavourable weather events. It also enables farmers to know well in advance about pricing and demand changes in the market, and thus to choose their best times to sow, harvest, and sell produce in order to maximize profits. Precision farming methods have been greatly improved by AI, allowing farmers to maximise crop yield and reduce resource wastage. AI also enables to gather data on crop health, soil quality, and moisture levels in real time using satellite imaging, drones, and sophisticated sensors. Farmers can utilise this data to improve their decisions about pest control, fertilisation and irrigation, which will result in a more focused and effective use of resources. By using less water, herbicides and fertiliser, this precision method not only increases crop yields but also supports sustainable farming practices. AI has developed a new programme called Plantix to address this problem. Farmers may forecast market trends and comprehend consumer preferences with the use of AI-powered market analysis tools. Disease and pests are the major threats to the economy, environment, and food security. Early detection of the disease play a crucial role in effective management of crop diseases. AI-based picture recognition systems enable to identify specific plant diseases and accordingly farmers can take effective control measures on their fields. Artificial intelligence (AI) algorithms enable to know about price trends and swings in demand.

DEVELOPMENT OF BIOCONTROL AGENT-BASED LIQUID INOCULANTS ON *PHOMOPSIS* FRUIT ROT DISEASE OF BRINJAL

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Abstract

Phomopsis fruit rot, caused by *Phomopsis vexans*, poses a significant threat to brinjal (*Solanum melongena*) production worldwide. Conventional fungicides have limitations in managing this disease due to resistance development and environmental concerns. Biocontrol agents offer a sustainable alternative, particularly in the form of liquid inoculants. This study investigates the efficacy of biocontrol-based liquid inoculants containing antagonistic microorganisms against *P. vexans*. In the present study, 9 *Bacillus* and *Pseudomonas* based liquid inoculants were prepared using different combinations of carrier



(nutrient broth), emulsifier (Tween 20), thickeners (sodium alginate, peg, corn cob powder and sugarcane bagasse) and protective agents (polyvinylpyrrolidone, glycerol and gum Arabic). The *Bacillus* and *Pseudomonas* consortium was added into these formulations, which was prepared with two bacterial cultures viz., *Bacillus* sp. and *Pseudomonas* sp. after finding that they were compatible with each other. The developed liquid inoculants were stored at room temperatures 28°C. They were characterized for shelf life (cell count), suspensibility and pH at 1 month interval up to 4 months. After 4 months of storage, the formulation F7 stored at 28°C showed highest cell count, pH, and low suspensibility. and were screened for various biocontrol activities

In the present study, the multitasking abilities of biocontrol agent i.e. *Bacillus* and *Pseudomonas* were exploited to see their role in controlling Phomopsis fruit rot in brinjal. These isolates were screened for biocontrol activities such as Dual culture. It was found that almost all liquid based formulation shows positive interaction to control Phomopsis fruit rot in brinjal. Therefore, these promising isolates can be used as proficient biocontrol agents against Phomopsis fruit rot which will promote sustainable and ecologically sound way of brinjal production. Overall, the potential of biocontrol-based liquid inoculants is effective and eco-friendly strategies for managing Phomopsis fruit rot in brinjal, offering sustainable solutions for disease control and crop improvement.

EFFECT OF PRE-HARVEST SPRAY OF PUTRESCINE, SALICYLIC ACID AND CALCIUM CHLORIDE ON BIOCHEMICAL QUALITY ATTRIBUTES OF PLUM CV. SATLUJ PURPLE UNDER AMBIENT STORAGE CONDITION

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Abstract

Plum botanically known as *Prunus* spp. is an important stone fruit, mainly grown in the temperate or cool subtropical regions of the world. Highly perishable nature of plum results a very short postharvest life which prevents the supply of fruits to distant global markets. Rapid fruit ripening and softening rate leads to lose of sensory quality attributes due to physico-chemical changes associated with ripening, such as changes in colour, aroma, texture and flavour. This results into a narrow harvest window in plum. Keeping these points in consideration an experiment was conducted at Horticulture Research Centre, Pattharchatta, G. B. Pant University of Agriculture and Technology, Pantnagar, during 2022-2023. The experiment was conducted to study the effect of different chemicals (viz. putrescine, salicylic acid and calcium chloride) on biochemical quality attributes (viz. TSS, titratable acidity, ascorbic acid, etc.) of plum fruits under ambient storage condition. The experiment was laid out in factorial randomised block design with thirteen treatments and one replication in each. The result revealed that all treatments were reported superior in compare to control. Thus it can be concluded that the application of these chemicals significantly influences the biochemical quality attributes of plum.

AGROFORESTRY : AN ALTERNATIVE SOLUTION TO CLIMATE CHANGE

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Abstract

Global climate change, marked by shifts in long-term weather patterns, is driven significantly by human activities such as the burning of fossil fuels. This has led to increased greenhouse gas concentrations, causing warming and altering ecosystems, human health, and weather patterns worldwide. Agroforestry, a sustainable land-use system that integrates trees, crops, and livestock on the same land unit, offers a dual approach to climate change mitigation and adaptation. By enhancing carbon sequestration and reducing CO₂ emissions, agroforestry systems contribute to climate change mitigation. Agroforestry systems significantly contribute to carbon sequestration, helping to offset CO₂ emissions. Trees planted alongside crops or integrated with livestock capture and store carbon in both the biomass and soil. For example, in agroforestry systems with



species like *Gmelina arborea*, carbon sequestration can reach up to 31.37 tC/ha over six years, while *Alnus nepalensis* and *Dalbergia sissoo* sequester 0.256 tC/ha/year and 0.141 tC/ha/year, respectively? Additionally, agroforestry systems enrich soil through litter fall, boost biodiversity, and provide ecological services such as watershed protection and phytoremediation. These rates mentioned are estimates and depend on various variables such as soil conditions, climatic factors, and management practices. Studies suggest that agroforestry systems with a mix of these species can enhance carbon storage while providing other ecological benefits like soil enrichment and biodiversity conservation. Economically viable and ecologically sustainable, agroforestry systems increase farm productivity, enhance ecosystem resilience, and offer a pathway for adapting to adverse climate impacts. Through careful species selection, such as *Acacia catechu*, *Dalbergia sissoo*, and *Mangifera indica*, agroforestry systems provide food security while delivering critical environmental services, emphasizing their role as a cornerstone in combating climate change.

LONG-TERM SUSTAINABLE MANAGEMENT OF NATURAL RESOURCES : A COMMUNITY-CENTRIC APPROACH

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Abstract

Long-term sustainable management of natural resources depends on the active support and involvement of local populations. In India, Joint Forest Management (JFM) has been implemented over the past two decades to bridge the gap between community goals and forest conservation, achieving mixed outcomes. The introduction of the Forest Rights Act (FRA) of 2006 marked a transformative policy shift, granting forest-dwelling communities legal rights to access and manage forest resources. The enactment of the FRA has further reshaped forest governance, complementing and complicating JFM efforts by recognizing individual and community forest rights. While this devolution process has empowered communities, its impact on public perceptions of forests remains poorly understood. This study investigates the interrelationships between (i) awareness of the Forest Rights Act, (ii) attitudes toward state authorities, and (iii) perceptions of state-managed forests (reserved forests). Understanding these dynamics is critical for designing inclusive and adaptive management strategies that align conservation goals with community aspirations, ensuring sustainable resource governance. Over the years, JFM has been instrumental in regenerating degraded forests, promoting biodiversity conservation, and improving rural livelihoods. States like Odisha, West Bengal, and Madhya Pradesh have demonstrated significant success through the implementation of JFM policies, supported by national guidelines and state-level frameworks. Joint Forest Management (JFM) in India has achieved significant coverage since its inception. By 2023, over 36 million hectares of forests were under the JFM framework, involving around 118,000 Joint Forest Management Committees (JFMCs) across the country. These committees actively engage local communities in protecting and managing forest resources. Odisha has been a pioneer in adopting JFM practices, having established its first policies even before the National Forest Policy of 1988. Currently, more than 12,000 JFMCs are operating in Odisha, managing substantial forest areas in collaboration with the state government. Future success depends on addressing policy gaps, enhancing community participation, and ensuring equitable benefit-sharing.

CLIMATE RESILIENT HIGH SEED AND OIL YIELDING SUNFLOWER HYBRID : TILHANTEC-SUNH-2 (IIOH-460)

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Abstract

To develop highly heterotic hybrids for achene and oil yield coupled with resistant to major disease and tolerant to major insect pests for commercial cultivation in rainfed conditions is an important breeding goal for sunflower. Sunflower, being a highly cross-pollinated crop is ideally suited for exploitation of heterosis. In view of the growing demand for edible oils in the country, there is an urgent need to develop high yielding hybrids and enhance the productivity suited to rainfed areas of the country. Performance of TilhanTec-SUNH-2 was assessed at 31 locations, respectively, during the *kharif* season over three



years through All India Coordinated Trials and a state multilocation trial at three locations during *kharif* 2021. A total of nine quantitative observations were recorded. Significant achene yield superiority (22.7% and 8.7%) was observed in AICRP trials over two national checks DRSH-1 and KBSH-44, respectively. Oil yield superiority was 21.2% and 28.2% compared to national checks DRSH-1 and KBSH-44, respectively. In the state multilocation trial, conducted at three locations, viz., Bengaluru, Hiriya, Gunjevu in Karnataka state during *kharif* 2021, entry IIOSH-460 registered a mean seed yield of 2385 kg/ha and had a yield advantage of 27.8% and 46.3% over the popular hybrids KBSH-53 and KBSH-78. Whereas, it exhibited 13.1% higher seed yield over popular private hybrid GK-2002. Apart from seed yield, it recorded a 705 kg/ha oil yield, which is 72.8%, 53.9%, 35.6% and 14.1% higher than KBSH-78, KBSH-53, KBSH-44 and RSFH-1887, respectively. Downy mildew disease reaction in sick plot, the hybrid IIOSH-460 recorded highly resistance reaction (0%) showed against susceptible reaction recorded by check hybrids KBSH-44 (51.7%) and DRSH-1 (67.5%), respectively. It is also moderately resistant to leafhoppers. A total of 80 SSR primers were used for DNA fingerprinting. Four SSR markers, viz., ORS-57, ORS-203, ORS-1028 and ORS-598 can be confidently used for the identification of TilhanTec-SUNH-2 as well as for genetic purity tests. It is recommended by CVRC for commercial cultivation in rainfed conditions of the sunflower growing states of India. This hybrid can replace the existing popular public and private hybrids and will be beneficial for farmers and growers.

BREEDING WHITE ONION FOR INDUSTRIAL PURPOSES

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Abstract

Onion (*Allium cepa*) is an important vegetable-cum-spice crop with importance for raw and cooked consumption, and in medicinal preparations. In addition, it has varied alternate uses in dehydrated form. These altered uses make onion farming more thriving and sustainable. The dehydrated onion products marches the modern lifestyle without compromising its sensory properties. Therefore, the breeding efforts need to be focussed towards suitability to dehydration. Various traits like white skin colour, TSS, dry matter content, appropriate sugar composition, pungency and storability in addition to yield needs to be targeted while breeding onion for industrial purposes. In this context, an attempt was made at ICAR-DOGR, Pune to improve TSS through simple recurrent selection in white onion germplasm collection since 2000. The resulting selects along with their basal germplasm accessions and commercial varieties were evaluated during winter season of 2021-22. The results indicated considerable variability contained in selects. The traits TSS recorded a notable improvement. The yield traits as well as TSS in the selects recorded considerable improvement over the basal germplasm. Based on mean performance, it was noted that the best performers for TSS included only the selects indicating favourable response to selection. The principal component analysis indicated that the yield traits viz., plant height, leaf diameter, pseudostem length, pseudostem diameter, marketable bulb weight, marketable yield and total yield contributed maximum to the variability in the PC1. The traits number of leaves, leaf length, polar diameter (bulb), equatorial diameter (bulb) and TSS contributed to maximum variability in PC2. The positioning of TSS in PC2 indicates lesser variability in TSS when compared to yield traits referring requirement of stricter selections for TSS. The best selects with respect to TSS along with yield may be used for industrial purposes directly or utilized in further improvement.

BI-IONIC POTENTIAL AND CONDUCTIVITY AS A TOOLS FOR ASSESSING SELECTIVITY IN COBALT(II) MOLYBDATE PARCHMENT-SUPPORTED MEMBRANE

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Abstract

Ion transport across a Cobalt (II) Molybdate membrane impregnated with parchment was investigated. To include the CoMoO₄ precipitate, the parchment paper was treated with CoCl₂ and Na₂MoO₄ solution salts. This alters transport phenomena in membranes by decreasing pore size and increasing the effective fixed charge. To evaluate the membrane's



selectivity using predetermined inter-membrane mobility ratio values, the conductivity of the membrane in contact with a 1:1 electrolyte was measured experimentally. The order of the membrane's ion selectivity has been determined to be $K^+ > Na^+ > Li^+$, reflecting the weak field strength of the charged groups linked to it.

ORGANIC MANAGEMENT OF ROOT KNOT NEMATODE (*MELOIDOGYNE JAVANICA*) IN LENTIL (*LENS CULINARIS*)

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Abstract

Root-knot nematode, *Meloidogyne javanica*, poses a considerable threat to lentil (*Lens culinaris*) cultivation, necessitating sustainable management strategies. This study addresses this gap by evaluating the efficacy of bio-organics and bio-pesticides in mitigating *M. javanica* induced damage. The research objectives include assessing the reduction in nematode populations, evaluating improvements in lentil yield, and offering practical solutions for farmers seeking sustainable alternatives to chemical interventions. Used bio-organics i.e. Neem cake, Vermicompost, Cowdung manure and Poultry manure doses used @ 1000 kg/ ha. of each and Biopesticides i.e. *Trichoderma harziznum*, *Purpureocillium lilacinum* and *Pseudomonas fluorescens* were used @ 2.0 kg/ ha. of each applied as soil application at the time of sowing. The statistical design RBD used for data analysis. Average of Initial Nematode Population of three years was 485.66 J₂/ 200 CC Soil. The result findings of this research study was recorded the best bio-organics neem cake @ 1000 kg / ha. highest yield (17.038) quintals/ hectare followed by the best bio-pesticide *P. lilacinum* @ 2.0 kg / ha recorded highest yield (16.204) quintals/ hectare. In nematode reproduction parameters recorded minimum RKI (1.083) and final nematode population (343.083) in neem cake followed by *P. lilacinum* @ 2.0 kg / ha recorded minimum RKI (1.583) and final nematode population (451.667). Ultimately, the study's outcomes offer a pathway towards more sustainable and resilient lentil cultivation practices, emphasizing the need for holistic and environmentally conscious approaches to root-knot nematode management in lentil farming systems. Bio-organics and bio-pesticides reducing nematode population, enhancing and improving lentil yield.

TRAINING NEEDS AND CHALLENGES OF FPOS IN RAMGARH, JHARKHAND

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Abstract

This study explores the training needs and operational challenges faced by members of Farmers Producer Organizations (FPOs) in Ramgarh District, Jharkhand, aiming to enhance the effectiveness of FPOs in supporting small and marginal farmers. FPOs are crucial in helping farmers aggregate resources and access better market opportunities, yet many face challenges that hinder their effectiveness. The research, based on a survey of 300 FPO members across six blocks, identifies key areas where training is needed, such as storage management, membership growth, product seasonality, professional business skills, and financial management. Additionally, it highlights operational constraints like marketing difficulties, competition from branded products, and a lack of professional business skills, which impact the overall performance of FPOs. The findings reveal that while basic agricultural skills and packaging are less prioritized, there is a strong demand for training in areas that enhance market access and business sustainability. A preferred training format is a concise 5-day program conducted before the agricultural season at the Krishi Vigyan Kendra Ramgarh, for convenience and accessibility. The study emphasizes the need for targeted training interventions that focus on improving FPO members' financial management, marketing capabilities, and operational strategies. By addressing these gaps, FPOs can be better equipped to help small farmers navigate the challenges of the agricultural market, leading to improved economic sustainability and market competitiveness. In conclusion, this research underscores the importance of tailored training programs to enhance the skills



and professional capacities of FPO members, ensuring that they are well-positioned to contribute effectively to the agricultural economy and improve the livelihoods of small farmers in the region.

OPTIMIZING ORGANIC FODDER PRODUCTION: INTEGRATED NITROGEN FERTILIZATION IN MAIZE-COWPEA INTERCROPPING FOR SUSTAINABLE DAIRY FARMING

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Abstract

The demand for sustainable agricultural practices has driven increased interest in organic fodder production systems, especially to support organic dairy farming and minimize reliance on synthetic inputs. Intercropping cereals and legumes presents a promising solution, leveraging efficient nutrient use, improved soil fertility, and enhanced crop yields. However, achieving optimal yield and nutritional quality in organic systems requires tailored fertilization strategies. This study explores the effects of integrated nitrogen fertilization on organic fodder production within a maize-cowpea intercropping system. Conducted over two Kharif seasons (2022 and 2023) with six treatments and six replications, the research investigates the combined use of farmyard manure (FYM), plant growth-promoting rhizobacteria (PGPR), and a 3% foliar spray of panchagavya. The treatment with 100% recommended nitrogen dose (RDN) resulted in significant improvements in maize green fodder yields (33.1 and 41.4 t ha⁻¹) and cowpea fodder yields (8.0 and 8.4 t ha⁻¹), along with enhanced proximate and mineral composition. These findings underscore this approach as an effective strategy for organic fodder production to support sustainable dairy farming.

BIOCHEMICAL CHANGES AS DEFENSE RESPONSE DURING PATHOGENESIS BY *ALTERNARIA CYAMOPSIS* (RANG. AND RAO), ITS TOXIN AND FUNGICIDE TREATMENT IN CLUSTERBEAN [*CYAMOPSIS TETRAGONOLOBA* (LINN.)TAUB.]

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Abstract

The blight of clusterbean caused by *Alternaria cyamopsis* pathogen is responsible for inciting the production of toxin, therefore, characteristic symptoms are developed on the host by the toxins. Culture filtrate (crude toxin) was partially purified using ammonium sulphate precipitation method, which was further separated through Sephadex G-75 column and eluted with acetate buffer. The toxin as produced by *Alternaria cyamopsis* and fungicides (Mancozeb and Copper oxychloride) treated guar leaves were analysed for product of lipid Peroxidation Melondialdehyde (MDA) and activities of Superoxidedismutase (SOD), Ascorbate peroxidase (ASPO) and Catalase (CAT). An increased level of MDA and activities of SOD and ASPO after 3 days and 9 days of challenge inoculation, whereas, toxin treated guar leaves showed higher level of MDA and activities of SOD and ASPO. Our results show the presence first line of the defense response as seen by induction of higher levels of MDA and increased activities of SOD and ASPO after challenge inoculation with *A. cyamopsis* whereas, fungicide treatment is found to keep this defense response at a slighting lower level.

ENHANCING CROP RESISTANCE TO HEAT STRESS THROUGH GENOMIC SELECTION

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Abstract

Enhancing crop resistance to heat stress through genomic selection is a crucial focus in plant breeding as global temperatures rise. Heat stress negatively affects crop growth, development, and yield, threatening food security. Genomic selection, which uses DNA markers to predict and select desirable traits, offers an efficient method to breed heat-tolerant crops. Heat stress



impacts key physiological and biochemical processes in plants, including photosynthesis and enzyme activity. Crops like wheat, maize, rice, and soybeans are particularly sensitive to heat during reproductive stages. Traditional breeding can be slow, whereas genomic selection accelerates the process by leveraging molecular genetics. It relies on high-density molecular markers to estimate the genomic estimated breeding value (GEBV) for heat tolerance, allowing breeders to identify heat-resistant candidates without direct phenotyping.

The process begins with a reference population that's been evaluated for heat tolerance traits like chlorophyll retention and spikelet fertility. Here is a step-by-step overview of the genomic selection process: 1) Identify a Reference Population, 2) Phenotyping: Assess the population's heat tolerance under controlled conditions, recording traits like yield and flowering time. 3) Genotyping: Use DNA sequencing to generate molecular markers across the genome. 4) Develop Prediction Models 5) Calculate GEBVs: Estimate breeding values (GEBVs) for heat tolerance. 6) Select Candidates: Choose plants with the highest GEBVs. 7) Validation: Field-test selected plants in diverse conditions. 8) Advance and Release: Develop and release heat-resistant varieties to farmers. Genotyping and phenotypic data are combined to train prediction models, which breeders use to rapidly select heat-tolerant varieties. Combining genomic selection with techniques like CRISPR gene editing may further accelerate heat-tolerant crop development. In summary, genomic selection offers a powerful, adaptable approach for enhancing crop resilience to heat, supporting food security amid climate change.

GENETIC CHARACTERIZATION AND USE OF AGRO-MORPHOLOGICAL TRAITS FOR THE ASSESSMENT OF DIVERSITY IN CASTOR (*RICINUS COMMUNIS* L.) GERMPLASM LINES

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Abstract

Studies on the characterization of 69 accessions of castor (*Ricinus communis* L.) for eleven quantitative traits characters and 23 morphological traits led to determine the genetic divergence. These 69 accessions were grouped into 9 clusters using D² analysis. Grouping of genotypes into various clusters revealed that there was no relationship between geographical distribution and genetic diversity. Maximum inter cluster distance was observed between IV and IX (49.71) while the lowest divergence was noticed between clusters I and II (9.96) indicating close relationship and similarity for most of the traits of the genotypes in this cluster. The maximum intra cluster distance was recorded in cluster IX (12.0) followed by cluster V (10.40) and this might be due to limited gene exchange or selection practice among the genotypes for diverse characters. The inter cluster distance was higher than the intra cluster distance which indicates the existence of substantial diversity among the genotypes. Among the nine clusters studied, Total length of primary spike (38.10 %) followed by number of spikes per plant (27.3%) contributed highest towards genetic divergence followed by plant height (12%). Results showed that the difference between PCV and GCV was low indicating less impact of environment on trait expression. Principal component (PC) analysis revealed that first three PC axes explained 64.6% of the total multivariate variation while the first five PC axes explaining 81.7%. The developmental characters such as Total length of primary spike, number of spikes per plant, 100-seed weight were the major determinants of the genetic diversity in the collection. These results have an important implication for sesame germplasm characterization, improvement, agro morphological evaluation and conservation.

EFFECT OF MICRONUTRIENTS AND PLANT GROWTH REGULATORS ON FRUIT SET AND RETENTION IN BER (*ZIZIPHUS MAURITIANA* LAMK.)

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Abstract

The determination of fruit set has been used in ber as a consistent indicator of the real productivity level. Due to short flower life, prevalence of self and cross incompatibility, pollen sterility and synchronous protandrous dichogamy, fruit set in the ber largely depends on sources of pollination, its related factors like effective pollination period, pollinators, environmental conditions, and the success in fertilization. Hence, any factor that can extend the effective pollination period, pollen



germination and pollen tube growth such as the application of micronutrient or plant growth regulators, should be beneficial for fruit production. During 2020–21, 42 genotypes of ber were evaluated for fruit set at ICAR-CIAH, Bikaner. Simultaneously, a trial was conducted to find out the response of micronutrients and plant growth regulators on fruit set and fruit retention in the ‘Gola’ ber. Foliar sprays of micronutrients (Boron at 0.1% and Zinc at 0.5%) and graded doses (10, 20, and 30 ppm) of plant growth regulators (GA₃, NAA, kinetin, and benzyladenine) were applied at BBCH stage 54 (green bud) and 67 (flower fading *i.e.* most petal fall). The genotypes showed large variation in natural fruit sets. About 74 per cent of genotypes under observation exhibited fruit set less than 6 per cent. Intervention with micronutrients and plant growth regulators applied at two different stages bring a significant response on fruit set in Gola ber. Among the various treatments evaluated, the highest fruit set was observed with the application of 0.1% boron (B) at BBCH stage 67 (11.42%), followed closely by the application of 10 ppm gibberellic acid (GA₃) at the same stage (10.94%). Both treatments were statistically on par in terms of fruit set. However, the boron treatment demonstrated a superior fruit retention rate (80.38%) compared to GA₃ (63.68%). In contrast, the water-sprayed control trees recorded significantly lower fruit set (3.77%) and retention (56.52%). In conclusion, the application of Boron (0.1%) at BBCH stage 67 is an effective approach to enhance fruit set and retention in ber cv. Gola under the hot arid regions of Rajasthan.

EFFECT OF SULPHUR AND WEED MANAGEMENT ON YIELD ATTRIBUTES, YIELD AND QUALITY OF SOYBEAN (*GLYCINE MAX* L. MERRILL)

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Abstract

A field experiment was conducted during rainy season of 2023 at the Agronomy farm at School of agricultural sciences, Nagaland University to evaluate the effect of sulphur and weed management on yield attributes, yield and quality of soybean [*Glycine max* (L.) Merrill]. The sixteen treatment combinations comprising 4 sulphur treatments (S₀, S₁₅, S₃₀, and S₄₅ kg ha⁻¹) and 4 weed management treatments (weedy check, two hand weeding at 20 and 40 DAS, pendimethalin @ 0.75 kg ha⁻¹ and sodium acifluorfen + clodinafop propargyl @ 200 g ha⁻¹). All the weed management treatments significantly enhanced straw yield and grain yield of soybean over weedy check. Among the weed management treatments two hand weeding at 20 and 40 DAS produced significantly higher seed (3015.43 kg ha⁻¹) and straw (6073.76 kg ha⁻¹) yields compared to weedy check. Among the herbicidal treatment sodium acifluorfen + clodinafop propargyl @ 200 g ha⁻¹ produced significantly higher seed (2775.68 kg ha⁻¹) and straw (5738.77 kg ha⁻¹) yields compared to pendimethalin @ 0.75 kg ha⁻¹. Increasing rate of sulphur application up to 45 kg ha⁻¹ resulted in significantly increased seed yield (3223.18 kg ha⁻¹), straw yield (6178.68 kg ha⁻¹), protein yield (1441.33 kg ha⁻¹) and oil yield (734.48 kg ha⁻¹) of soybean.

HETEROSIS AND COMBINING ABILITY STUDIES IN GRAIN SORGHUM (*SORGHUM BICOLOR* L. MOENCH)

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Abstract

Hybrid sorghum development is an innovative and feasible breeding approach to rapidly boost sorghum production. Combining ability and heterosis analyses are essential for identifying elite parental lines and highly heterotic hybrids, advancing genetic improvements and facilitating sorghum cultivar development. Hence, this study was conducted at AICRP on sorghum, ARS Chamarajanagar to investigate the magnitude of combining ability and extent of heterosis among forty hybrids derived by crossing ten restorers along with four male sterile lines in line × tester mating design in *kharif* 2023 and evaluation of these hybrids along with two checks (CSH-30 and CSH-14) for twelve yield and yield attributing traits was carried out in a Randomized Complete Block Design (RCBD) in *kharif* 2024. Analysis of variance revealed the presence of considerable variability among genotypes. The high significance of line × tester effects for all the quantitative traits being studied that evoked the interaction between lines and testers is a key contributor to the observed variation. The magnitude of



SCA variance was higher than that of GCA variance for all the traits suggesting the predominance of non-additive gene action in the expression of the traits studied, which was also supported by $\sigma^2_{GCA} / \sigma^2_{SCA}$ less than unity for all the traits under consideration. Out of fourteen parents, one tester 463 A and three lines viz., SOR 3570, SOR 5002 and SOR 3350 were identified as the best general combiners for most of the yield and yield attributing traits. The top five crosses namely, 456 A $\times$ SOR 3570, 463 A $\times$ SOR 3570, 463 A $\times$ SOR 4346, 456 A $\times$ SOR 6852 and 463 A $\times$ SOR 11942 were identified with high per se performance, highly significant *sca* effects as well as highly significant standard heterotic effects for grain yield per plant over CSH-30.

AGROFORESTRY: A TOOL TO IMPROVE AND SUSTAIN SOIL HEALTH

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Abstract

Agroforestry is used for an agricultural land management system in which agricultural field crops and livestock are integrated with trees and shrubs for long term sustainable farming and improvement of soil health. Agroforestry leads to an ecological diverse and productive land with lesser human interference, low cost, and long-term environmental benefits. Proper adaptation of agroforestry is useful to improve the living standard of people by enhancing health and nutrition and accelerating economic growth and environmental sustainability. The basis of the benefits provided by agroforestry is the interaction between the components of the system, i.e., trees, shrubs, crop, and cattle. In agroforestry the components are interlinked structurally and functionally such that they can be managed to get the best outcome from the system, for example, trees. The integration of trees into agricultural landscapes has the potential to generate several improvements in the soil as a habitat for soil organisms and also for crop growth. Soil improvements by trees can also occur by increased supply and availability of nutrients for crops and soil biota. and biological properties of soil that increase the overall growth of plants. Leaves of trees associated with the agricultural land fall off on the soilsurface that form a protective layer. This layer of litter adds organic matter to the soil after decomposition by microorganisms, reduces loss of moisture content, and also plays an important role in the prevention of soil erosion. Some of the physical properties that are indicative of soil health and influenced by agroforestry are soil binding stability, bulk density, water holding capacity, infiltration rate, depth of soil, and structure, texture, and porosity of soil. Other than the physical properties, there various chemical properties of soil that play an indicator in soil health and also influenced by agroforestry. Soil organic matter and soil organic carbon are reported to be increased in soil due to the addition of litter fall and dead root remains when crop is planted under old plantations. Soil pH is an important factor which influences the surrounding soil microbiota and the growth of plants. Soil pH is a major factor to control the presence of many nutrients and also decides their ionic form which further influences their uptake and growth of plants. Biological properties of soil include the number of microbes, enzymatic activity in the soil, carbon and nitrogen microbial biomass, soil basal respiration, and microbiota. These properties are influenced by organic matter present in the soil and soil organic carbon added by litter fall, decomposition of plant remains, and variety of litter depending on the different types of tree species under the agroforestry system.

HARNESSING AGRICULTURAL PRACTICES: INFLUENCE OF CONSERVATION TILLAGE AND NITROGEN ON WEED GROWTH IN MUSTARD

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Abstract

An experiment was conducted on Mustard (RH-725) at Research Farm, Department of Agronomy, CCS Haryana Agricultural University, Hisar (Haryana) during *Rabi*, 2022-23 and 2023-24 to study the effect of conservation tillage and nano-urea on weed density and weed dry matter. The experiment was carried out in split plot design with four tillage and mulch practices and five treatments of nitrogen levels in sub-plots and replicated thrice. The main plot treatments were CT- conventional tillage without mulching, CTM- conventional tillage with rice residue mulching at 6 t ha⁻¹, NT- no tillage with no mulching



and NTM- no tillage with rice residue mulching at 6 t ha⁻¹ and; treatments used in subplot were N₁- control, N₂- 100% RDN (recommended dose of nitrogen), N₃- 50% RDN as basal dose along with foliar spray of nano-urea at 3 ml L⁻¹ at branching, N₄- 50% RDN as basal dose along with foliar spray of nano-urea at 5 ml L⁻¹ at branching; and N₅- 50% RDN as basal dose along with foliar spray of nano-urea at 2.5 ml L⁻¹ at branching and initiation of flowering.

Among tillage and mulch practices, CTM reduced weed dry weight at 60 DAS by 6.13 percent compared to conventional tillage, while it was higher by 7.81 and 4.29 percent under NT and NTM respectively. For weed density, CTM caused a decrease of 4.75 percent over CT, while NT and NTM increased weed density by 9.09 and 4.61 percent. Among nitrogen levels, N₂, N₃, N₄ and N₅ increased weed dry matter and weed density by 6.61 and 5.79, 5.04 and 3.72, 5.35 and 4.96; and 4.72 and 4.41 percent, respectively compared to control. Conventional tillage demonstrates efficacy in weed management for mustard crop, while weed suppression remains more challenging under no-tillage systems. However, mulching presents a highly effective strategy for controlling weeds in both conventional and no-tillage practices. Nitrogen fertilization undoubtedly increases weed density and dry matter accumulation due to competitive nature of weeds.

EVALUATION OF SILKWORM LINES FOR IMPROVING PARENTAL RACES OF CSR DOUBLE HYBRID

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Abstract

India, the world's second-largest silk producer, saw bivoltine silk production rise from 14,432 to 36,582 MT (2000–2023, 3.7% CAGR), driven by innovative breeding and extension activities following international collaboration in the 1990s that led to the development of hybrids like CSR double hybrid, SH6xNB4D2, and CSR2xCSR4. These hybrids boosted bivoltine silk production and reduced reliance on multivoltine silk. However, the parental breeds (CSR2, CSR27, CSR6, CSR26) face stability issues in northern and northeastern regions, emphasizing the need for alternatives or trait improvements. This study addresses issues in parental lines using marker-assisted selection for high-temperature and high-humidity conditions in northern and northeastern regions. It involves six oval lines (2, 2A, 2B, 27, 27A, 27B) and four constricted lines (6, 6A, 26, 26A), reared across different seasons of 2022, 2023, and 2024. The aim of the study was to assess the performance of the mentioned lines under changing environmental variables, using stability analysis and evaluation indices for a comparative understanding, while providing insights to improve the CSR double hybrid. Key economic parameters—fecundity (FEC), yield (ERR), single cocoon weight (SCW), single shell weight (SSW), shell ratio (SR%), and pupation rate (PR%) showed varying ranges across oval and constricted lines. FEC ranged from 524-553 and 534-551, ERR from 12.35-13.15kg and 11.88-13.34kg, SCW from 1.64-1.70g and 1.60-1.71g, SSW from 0.31-0.33g and 0.31-0.32g, SR% from 19.03-19.94% and 18.63-19.64%, and PR% from 80.84-88.05% and 81.77-87.87%. Of the ten lines, only four (2A, 27, 27A, 27B, 26) exceeded the standard score (50). Stability analysis, based on the Francis Coefficient of Variation, showed higher mean and lower variation in FEC (2A, 2B, 27A, 27B, 26, 6A); ERR (2B, 27, 6A, 26, 26A); SCW (2A, 2B, 27A, 27, 6, 26, 26A); SSW (27A, 27B, 26, 26A); SR (27B, 27A, 26, 26A); and PR (2, 2B, 27, 27A, 6A, 26, 26A). In conclusion, this study provides insights into potential replacements for CSR double hybrid parents or candidates for identifying a stable double hybrid.

EVALUATION OF NUTRIGENETIC SILKWORM HYBRIDS: 50XN1, 50XN4, AND 14XN1

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Abstract

Silkworm larvae rely entirely on mulberry leaves for their growth, survival, and cocoon production. Their ability to ingest, digest, absorb, and convert nutrients into silk fiber varies depending on race/hybrid, environmental factors, voltinism, and nutritional factors. The aim of this study was to identify superior nutrigenetic hybrids. A total of 19 nutrigenetic traits, along with important economic traits, were estimated. After four seasonal trials conducted during spring and autumn, three



season-specific hybrids (50xN1, 50xN4, 14xN1) were shortlisted from 15 hybrids formed using the partial diallel method. The shortlisted hybrids were subjected to station trials at CSR&TI, Pampore (temperate region), RSRS Jammu, and Sahaspur (subtropical region) to assess their performance in diverse environments with varying weather conditions. The commercial hybrid SH6xNB4D2 served as the test control. A total of 10 Disease-Free Layings (DFLs) were cellularly reared, and data on important yield parameters were collected. Considerable variations were observed in the six station trials, with yields ranging from 59 to 70.81 kg/100 DFLs in 50xN4 and 57 to 67.43 kg/100 DFLs in 50xN1 during spring seasonal rearing. On the other hand, yields ranged from 59.5 to 62.65 kg/100 DFLs in 50xN1 and 63.2 to 67.34 kg/100 DFLs for 14xN1 during autumn seasonal rearing. The mean yields of the hybrids 50x N4 and 50xN1 during spring were 66.36 and 63.55 kg/100 DFLs, respectively. During the autumn season, the mean yields of 50xN1 and 14xN1 were 61.42 and 65.68 kg/100 DFLs, respectively. The mean yield of the control SH6x NB4D2 during spring and autumn was 55.69 and 52.49 kg/100 DFLs, respectively, indicating inferior performance compared to the test hybrids. The test hybrids showed a considerable improvement over the control during spring, with percentage improvement of 12.36% and 16.08% in 50xN4 and 50xN1, respectively. For autumn, the improvements were 14.54% and 20.09%, respectively.

EFFECT OF GUM ARABIC BASED EDIBLE COATING ON POST-HARVEST QUALITY OF LITCHI (*LITCHI CHINENSIS* SONN.) CV. ROSE SCENTED

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Abstract

Litchi (*Litchi chinensis* Sonn.) is an important subtropical evergreen perennial fruit tree known as the “Queen of fruits” and it has a limited shelf-life. Edible coating is a creative approach to enhance the shelf-life of fruits by creating a semi-permeable barrier that reduces respiration rate, regulates moisture loss and serves other purposes. The present study was conducted in June 2022 at the Postharvest Laboratory of the Department of Horticulture, College of Agriculture, G.B. Pant University of Agriculture and Technology in Pantnagar, Uttarakhand. The main aim of the study was to see the effects of gum arabic (10 %) based edible coatings incorporated with 1 % and 2 % of antioxidants (ascorbic acid and citric acid) on physico-chemical attributes and shelf-life of litchi fruits during storage. The experiment was laid out in Factorial Completely Randomized Design comprising of five treatments at five storage intervals (0, 4, 8, 12 and 16th days) at low temperatures (5 ± 1 °C) for periodical study. The results obtained from present investigation showed that gum arabic (1 %) incorporated with ascorbic acid (2 %) as an antioxidant was found more effective in physico-chemical attributes by reducing physiological loss in weight, browning percent (%) and decay percent (%); TSS and total sugar content of fruits up to sixteen days.

STUDIES ON MORPHOLOGICAL AND STOMATAL VARIATIONS IN KARONDA INDUCED THROUGH COLCHICINE TREATMENT

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Abstract

Polyploidization is an important technique used in fruit breeding to create new genetic resources and can be induced using some antimitotic agents, including colchicine. Plants with increased ploidy level can gain better quality than their original diploids in some characteristics. Kaornda (*Carissa carandas* L.) being an underutilized fruit crop, has a narrow genetic base. It is a very hardy and drought tolerant plant which thrives well throughout the tropical and subtropical climates. With an objective to increase the diversity in Karonda, an experiment was conducted at Medicinal Plants Research and Development Centre, G.B. Pant University of Agriculture and Technology, Pantnagar, Udham Singh Nagar (Uttarakhand). Seeds of Karonda were treated with different concentrations of colchicine viz., 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8 and 0.9% for 24 hrs. Maximum germination was recorded in control whereas, increase in colchicine concentration resulted into reduced germination. At 0.9 % no germination was recorded. The seedlings showing variation after germination were selected. Plant height, intermodal length, leaf colour and stomatal size were recorded. The assumed variants showed maximum plant height, more intermodal



length, bigger leaf size, darker leaf colour and maximum stomatal length which were found to be in C₃ (0.3%). The results of this investigation show that polyploidization has the ability to increase Kaornda's genetic diversity and produce new cultivars with desirable agronomic traits.

GENOME-WIDE SSR MINING, DEVELOPMENT OF NOVEL G-SSR MARKERS IN GUAVA (*PSIDIUM GUAJAVA* L.) AND ITS APPLICATION IN GENETIC DIVERSITY, CROSS-SPECIES AND GENERA TRANSFERABILITY STUDIES

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Abstract

Psidium guajava L. is one of the nutritionally rich major fruit crops, growing in tropical-subtropical regions of the world. To improve breeding efficiency and initiate molecular breeding, the self-sufficiency of genomic resources is of utmost importance for crop species. However, genomic resources like validated SSR markers are limited in public domain for guava. This study involves development of novel genome-wide SSR markers using the chromosome assembly (GCA_016432845.1) of the "New Age" guava cultivar with GMATA software. The software evaluated about 397.8 million base pairs (Mbp) of the guava genome sequence, where 87,372 SSR loci were utilized to design primers, which ultimately lead to create 75,084 new SSR markers. After *in silico* analysis, a total of 75 g-SSR markers were chosen to screen 35 guava and 5 jamun genotypes. Of the 72 amplified novel g-SSR markers (FHTGSSRs), 53 showed polymorphism, suggesting significant genetic variation among the guava genotypes, including wild species. Besides, in this study, the mean values recorded for MAF, gene diversity, observed heterozygosity, and PIC were 0.73, 0.38, 0.13, and 0.33, respectively. Among the wild *Psidium* species studied, the transferability of these novel g-SSR loci across different species was found to be 45.83% to 90.28%. Furthermore, 17 novel g-SSR markers were successfully amplified in all the selected jamun genotypes, of which only four markers could differentiate between two jamun species. Hence, these markers are not only useful for hybridity confirmation and marker-assisted selection but also exhibit cross-species transferability within *Psidium* spp. and cross-genera transferability among *Syzygium* spp., making them valuable resources for genetics and breeding studies for both guava and jamun.

PESTICIDES, INSECTICIDES AND THEIR ECOTOXICITY

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Abstract

Pesticides and insecticides are widely used to control pests and insects in agriculture. For crop protection, use of chemical fertilizers, pesticides and insecticides was increased. Bio-magnification of pesticides is a major concern today, these chemicals compounds remains in environment for a long time and cause ecotoxicity. Endosulfan, Laraforce, Diazol, Aldicarb, Lefenuron, Pyrinex Lorsban, Sniper, Cydim super, Talstar and Roundup are commercially available pesticides. They can affect humans, plants and animals directly on the site of application or remain in ecosystem. Their residual remains in the soil for a long time and cause soil desertification, their spread through air affect birds and insects and runoff with water streams affect aquatic ecosystem. They affect the survival, reproduction and behaviour of birds, bees that help in pollination of crops. Ecological risk assessment of pesticides is of utmost importance. Instructions of usage accidental spillage must be strictly adhered too. Sustainable method of pest management should be adapted to reduce ecotoxicity. Microbial pesticides, biopesticides, bioinsecticides, nanobiopesticides are available for pest and insect control. They are biodegradable,



eco-friendly and less toxic. They act by insects gut disruption, paralysis, repellance and affect growth and metabolism of insects and pest. Genetically modified insect and pest resistant crops have also been developed by molecular breeding, gene pyramiding and RNAi interference. Insect pest management by biological methods or development of resistant varieties can be a better approach to combat food insecurity and for sustainable ecosystem.

OPTIMIZING NUTRIENT ABSORPTION AND QUALITY TRAITS IN CHICKPEA-BASED INTERCROPPING SYSTEMS VIA FOLIAR APPLICATIONS OF NPK AND GIBBERELIC ACID

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Abstract

A study was carried out during the *Rabi* seasons of 2019-20 and 2020-21 at Birsa Agricultural University, Ranchi, employing a split-plot design with three replications. The experiment included nine main plot treatments: sole chickpea, wheat, linseed, safflower, mustard, and intercropping systems of chickpea + wheat (6:3), chickpea + linseed (6:2), chickpea + safflower (6:2), and chickpea + mustard (6:2). Sub-plot treatments consisted of a control (water spray), 1% NPK (19:19:19), and GA₃ (100 ppm) foliar sprays. The findings indicated that the intercropping system of chickpea + mustard (6:2) produced the highest grain yield (1273 kg/ha), protein and oil content, and total nitrogen uptake (93.56 kg/ha), followed closely by chickpea + linseed. Sole wheat recorded the highest total phosphorus uptake (23.25 kg/ha), while sole mustard achieved the maximum potassium uptake (67.36 kg/ha). Among foliar spray treatments, the application of 1% NPK (19:19:19) at 45 days after sowing significantly enhanced protein content and total phosphorus uptake across component crops. On the other hand, the application of GA₃ (100 ppm) at 45 days after sowing resulted in the highest grain yield, oil content, and total uptake of nitrogen and potassium during both experimental years. The study highlights the potential of intercropping systems, particularly chickpea + mustard, and the strategic use of foliar sprays like GA₃ and NPK, in optimizing yield, nutrient content, and resource use efficiency in chickpea-based intercropping systems.

GROUNDNUT IMPROVEMENT THROUGH MOLECULAR BREEDING APPROACHES

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Abstract

Groundnut or peanut (*Arachis hypogaea* L. Millsp) is a self-pollinated species belonging to the Fabaceae family. It is considered as the most important food legume crop in continental Africa because of its multiple purpose uses in food, feed, paints, lubricants and insecticides as the seeds are comprised of 35–56% oil, 25–30% protein, 9.5–19.0% carbohydrates, several minerals like P, Ca, Mg and K, as well as vitamins E, K and B. Improved varieties of groundnut with high yield potential were developed and released for cultivation world over. The improved varieties belong to different maturity durations and possess resistance to diseases, tolerance to drought, enhanced oil content, and improved quality traits for food uses. Conventional breeding procedures along with the tools for phenotyping were largely used in groundnut improvement programs. Mutations were used to induce variability and wide hybridization was attempted to tap variability from wild species. Low genetic variability has been a bottleneck for groundnut improvement. The vast potential of wild species, reservoir of new alleles remains under-utilized. Development of linkage maps of groundnut during the last decade was followed by identification of markers and quantitative trait loci for the target traits. Consequently, the last decade has witnessed the deployment of molecular breeding approaches to complement the ongoing groundnut improvement programs in USA, China, India, and Japan. The other potential advantages of molecular breeding are the feasibility to target multiple traits for improvement and provide tools to tap new alleles from wild species. The first groundnut variety developed through



marker-assisted back-crossing is a root-knot nematode-resistant variety, NemaTAM in USA. The uptake of molecular breeding approaches in groundnut improvement programs by NARS partners in India and many African countries is slow or needs to be initiated in part due to inadequate infrastructure, high genotyping costs, and human capacities. Availability of draft genome sequence for diploid (AA and BB) and tetraploid, AABB genome species of *Arachis* in coming years is expected to bring low-cost genotyping to the groundnut community that will facilitate use of modern genetics and breeding approaches such as genome-wide association studies for trait mapping and genomic selection for crop improvement.

TITLE-ROLE OF ENGINEERED APOMIXIS IN THE FIELD OF AGRICULTURE

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Abstract

Engineered apomixis has the potential to revolutionize agriculture by enabling plants to reproduce asexually through seeds without the need for fertilization. This technology offers several benefits that can significantly impact crop breeding, seed production, and farming practices. Firstly, fixation of hybrid vigor (Heterosis) in which engineered apomixis allows the production of seeds that are genetically identical to the parent hybrid plant. This means that the hybrid vigor can be preserved indefinitely, eliminating the need to produce new hybrid seeds every season. Secondly, Cost Reduction for Farmers by lowering seed costs since apomictic plants produce genetically identical seeds, farmers do not need to purchase new hybrid seeds each season. They can save seeds from one harvest and use them for the next, significantly reducing seed expenses. Thirdly, stability of desired traits in which the exact genetic makeup of the parent plant is preserved in each generation, ensuring that the traits farmers want to maintain are reliably passed on. Fourthly, acceleration of plant breeding programs via rapid development of new varieties: Engineered apomixis can help plant breeders quickly stabilize and propagate new crop varieties with desirable traits. This accelerates the breeding cycle, which is typically slow when using traditional breeding methods. Fifthly, enhancing food security with the ability to propagate crops with specific traits such as heat, drought, or flood resistance; engineered apomixis can contribute to crop adaptation to climate change, ensuring food production remains stable under changing environmental conditions further sustainable agriculture reduces need for chemical inputs like fertilizers and pesticides (due to uniform plant growth and pest resistance) aligns with sustainable agricultural practices, benefiting both the environment and human health. Sixthly, empowerment of smallholder farmers through apomixis technology can provide smallholder farmers, especially in developing countries, with access to high-quality seeds that they can save and replant without the need to purchase expensive hybrid seeds and reduce dependency on large seed companies and enhances the economic independence of small-scale farmers, promoting equitable agricultural growth. Seventhly, potential for new crop varieties as it could facilitate the development of new crop varieties that were previously difficult to stabilize through traditional breeding, opening up new possibilities in crop diversity and resilience. Challenges associated with engineered apomixis are like Technological barriers, Regulatory and bio safety issues & Intellectual property rights. Engineered apomixis has the potential to transform agriculture by making hybrid crops more accessible, reducing seed costs, enhancing food security, and promoting sustainable farming practices. Its ability to produce genetically uniform and high-performing plants could be a key factor in addressing global challenges like climate change, population growth, and food scarcity. However, addressing the technological, regulatory, and economic hurdles is essential for its successful implementation in mainstream agriculture.

IMPACT OF STOCK DENSITY ON PROXIMATE COMPOSITION AND QUALITY OF RED TILAPIA IN INLAND SALINE GROUND WATER BIOFLOC SYSTEMS

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Abstract

For the rearing of red tilapia, *Oreochromis mossambicus* × *Oreochromis niloticus*, a biofloc-based intensive system is most preferable. Red tilapia fingerlings were stocked in triplicate at different stocking densities of 150 (SD1), 200 (SD2), 250



(SD3), and 300 (SD4) no. m⁻³ in biofloc-based treatments and 150 no. m⁻³ in control (C) means clear water in inland saline ground water of 20 ppt to determine the optimum stocking density over the duration of an experiment lasting 90 days. Proximate composition and texture analysis of red tilapia were measured at the end of the experiment. Significantly higher value of dry matter (27.6 ± 0.51) and crude protein (14.46 ± 0.20) were observed in SD1 and lowest value was recorded in control group. Crude lipid was found lowest in control (5.62 ± 0.28) and higher in SD3 (6.74 ± 0.17). The ash value was highest in SD4 (4.50 ± 0.26) with significantly compared to the control group and SD1, with lowest value (3.62 ± 0.07). Texture analysis was indicated by higher firmness in SD1 (50.2 ± 3.65) and lowest was in control (39.77 ± 4.6). Colour analysis indicated highest lightness (L*) value in control and lowest in SD1. The redness/greenness (a*) (1.77 ± 0.12) in SD2 fishes was highest followed by SD1 (1.74 ± 0.17) and lowest was in control group (0.69 ± 0.15) with significance difference. SD1 group is having lowest yellow/ blueness (b*) (2.29 ± 0.02) which did not vary significantly with other group, whereas whiteness value varied significantly with highest value in control group (43.22 ± 0.69) and lowest in SD1 (41.91 ± 0.74). As a result, 150 nos. m⁻³ is recommended stock density for the texture/color and composition quality in 20 ppt salinity for the rearing of red tilapia in biofloc system in inland saline ground water.

EFFECT OF AGE OF SEEDLINGS ON GROWTH AND YIELD OF TOMATO CV. ARKA RAKSHAK.

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Abstract

The tomato (*Solanum Lycopersicon*) is an edible fruit belongs to family Solanaceae. India is second highest in tomato production followed by Nigeria. In India Madhya Pradesh holds the first position with production of 2805.07 thousand metric tonnes in the year 2020-2021. The production of Bihar was 951.36 thousand tones with production share of 4.53 % during 2020-21. It is an important protective food due to rich source of minerals like calcium (48mg/100mg), Sodium (12.9 mg), trace elements and other vitamins and minerals. The quality of seedlings in tomato cultivation plays an important role for good growth and higher yield. For raising healthy seedlings, the nursery beds should be well prepared along with soil treatment, seed treatment, light irrigation and all intercultural operations will be done in well manner. The findings of transplanting of 30 days old seedlings with root treatment rhizobacteria was best. The maximum plant height 62.68 cm, highest number of primary and secondary branches 7:43 & 9.65 per plant, highest yield 309.27 Q/ha was recorded in transplanting of 30 days old seedlings along with root dip in rhizobacteria solution as compared to other treatments. The maximum gross return 247426 Rs/ha net return 184742.28 Rs/ha with highest BC ratio 3.95 was recorded in case of this treatment as compared to other treatments. The healthy crop of tomato depends on healthy seedlings and soil environment. The seedlings treatment with rhizobacteria solution improves the microbial communities around the rootzone. In this trial the best Suitable age of seedlings was 30days with root treatment with rhizobacteria solution for getting healthy crop with good and higher yield in Agro climatic and soil condition of Nalanda district in Bihar.

GENDER DYNAMICS IN PRODUCTION AND INFORMATION USAGE: A COMPARATIVE ANALYSIS OF NORTH EASTERN AND NORTH WESTERN HIMALAYAN REGIONS

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Abstract

In hills, women are the dominant cultivators because of men's migration for livelihoods. In an ecosystem where women participate in farming predominantly, it becomes imperative to map their information networks and provide suggestions for effective information usage by women farmer vis-à-vis men. This study was carried out in states of NW Himalayan and NE Himalayan region –Uttarakhand and Sikkim- to explore the gender issues in vegetable cultivation, gender dynamics in households engaged in vegetable cultivation, constraints faced, and the usage of information sources by the vegetable growers. It is a unique comparative study which attempted to study the information acquisition pattern of the vegetable growers of NW and NE Himalayan region with a gender perspective using social network analysis. Female vegetable growers



experienced lack of time, lack of irrigation sources, lack of knowledge about training institutions, high input costs and a shortage of high-quality raw materials while for male farmers, lack of training and skills, high cost of input, lack of timely access to seeds and other inputs, inadequate knowledge about training institutions and low prices of vegetables were the major constraints. Local Interpersonal sources of information are quite popular among women farmers, more formal and Cosmopolite Interpersonal information sources were preferred by the male vegetable growers. In NE state, not much difference was seen in accessing the information sources across gender and the gender gap was less than NW state.

IMPACT OF AGROFORESTRY SYSTEM ON SOIL MICROCLIMATE, NUTRIENT STATUS, AND BIOMASS PRODUCTIVITY IN SLOPED TERRAINS

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Abstract

Agroforestry systems integrating *Gmelina arborea*, a fast-growing multipurpose tree species, hold significant potential for enhancing soil health, regulating microclimate, and improving productivity, particularly in sloped terrains prone to soil erosion and nutrient depletion. This study evaluates the impact of *Gmelina arborea*-based agroforestry systems on soil microclimate, nutrient status, and biomass productivity in sloped landscapes. Key parameters assessed include soil temperature, moisture content, organic carbon levels, macronutrient (N, P, K) availability, and plant biomass accumulation across various system components. Results indicate that *Gmelina arborea* influences the soil microclimate by reducing temperature fluctuations and maintaining higher moisture levels due to enhanced canopy cover. Biomass productivity was significantly higher under agroforestry compared to sole cropping systems, demonstrating the synergistic benefits of tree-crop interactions. The study underscores the role of *Gmelina arborea* agroforestry systems in creating resilient agroecosystems by mitigating soil degradation, improving microclimatic conditions, and enhancing productivity on sloped terrains. These findings support the adoption of agroforestry as a sustainable land-use strategy in hilly regions, aligning with goals of climate-smart agriculture and rural livelihood enhancement.

EFFECT OF MOISTURE STRESS ON INDIAN MUSTARD MORPHO-PHYSIOLOGICAL TRAITS

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Abstract

An experiment was conducted during *rabi* 2021-22, the experimental material used for trial included the twenty-two Indian mustard varieties, genotypes and entries which were already identified for drought resistance and the site of the experiment was ICAR-Directorate of Rapeseed-Mustard Research, Sewar. The experiment was laid out in two sets of trials, one under timely sown irrigated condition and the other under timely sown *rainfed* condition. Two irrigation was given to the timely sown irrigated trial, whereas no irrigation was given to the timely sown *rainfed* trial. Cultural operations like thinning and weeding were also carried out during the initial germination and growth of the crop. Simultaneously, two sets were also sown in the root blocks under *rainfed* and irrigated conditions. In both the trials, growth and development parameters, physiological and biochemical parameters were observed during the cropping season and yield and yield attributes along with root morphological attributes were recorded at harvest. In the second year of the experiment, various traits were observed that were affected by moisture stress like plant height, number of branching, canopy temperature, plant pigments concentration, number of siliquae per plant, test weight, biological yield and seed yield etc. When compared to irrigated conditions, genotypes CS 60, DRMR-SJ-276, RH-725, DRMR 2017-17, DRMR 541-44, DRMR 2018-17, RH-406, DRMR SJ-126 and RGN-229 showed less reductions under *rainfed* conditions in growth attributes like plant height (cm), No. of primary branches, No. of secondary branches. Whereas, under *rainfed* conditions, the impact of moisture stress results in minimum reduction of biochemical parameters such as RWC, Chl a and b, total chl, and carotenoids in genotypes Kranti, DRMR-SJ-25, DRMR 2017-24, DRMR 541-44, DRMR 2018-17, DRMR 10-40, DRMRHT 13-22-2. The highest value with the least reduction in yield and yield attribute and HI were observed in genotypes CS 60, DRMR-SJ-166, RH-725, as well as these genotypes also had lower DSI values (=0.5) and higher YSI values.



SHEEP REARING MEANS OF LIVELIHOOD FOR SHEEP SHEARERS IN CHANGING SCENARIO OF WOOL PRICE

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Abstract

Increasing availability of synthetic and semi-synthetic fibers in Indian textile manufacturing industries and poor quality of Indian wool, sheep farmers are not getting fair price for wool. Due to the declining prices of wool, now the main purpose of sheep rearing in India is meat production only. Sheep farmers in semi-arid region of Rajasthan employed a number of strategies to meet household needs. Among different coping strategies, sale of small ruminants (17.2%) was the most employed strategy (Gurjar *et al.* (2018). The farmer is not getting the income from sheep's wool even equal to the expenditure on sheep shearing, which has a direct impact on the income of the farmer from sheep rearing. Reducing the number of sheep shearing also affects sheep health and the effect of shearing sheep according to the requirement, falls on the income of the sheep farmer. In this anomalous environment of sheep rearing where the prices of wool are continuously decreasing, the trend of sheep shearing business has also started changing. Keeping all these facts in mind, on the change in the trend of sheep shearing business, this study was conducted in 20 villages of Malpura tehsil, Tonk district of Rajasthan state and a total of 200 sheep rearers were selected purposively to collect the information on sheep population in village, times of shearing in a year, sheep shearing cost, wool production and price of wool. Study revealed that average sheep rearers were 10 and sheep 400 in a village. Most of the respondent response that three times shearing of a sheep in year and cost of shearing was Rs. 20/sheep and wool production 400 gm/sheep. Wool price was Rs.35/kg and 60 sheep were shear per day by sheep shearer. Income of sheep shearers was Rs. 24000/ village in a year. One sheep shearer cover about 05 villages in a year and total income earned Rs. 120000. Thus, the study concludes that sheep production augmenting the economic condition of various stakeholders related to sheep husbandry.

MORPHO-PHYSCOCHEMICAL BEHAVIOUR OF SELF-ROOTED AND GRAFTED PLANT TYPES OF CITRUS ROOTSTOCKS UNDER WATER DEFICIT REGIMES

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Abstract

Citrus fruits, celebrated for their vibrant flavors and rich nutritional profile, are cultivated across more than 140 countries, thriving in a range of climates and agro-ecological environments. However, these crops face significant challenges from water deficits, which require adaptive strategies for their survival and productivity. This study explores the mechanisms of tolerance to water stress in two citrus rootstocks, *Jatti Khatti* (C. jambhiri Lush.) and X639 (a hybrid of *C. reshni* Hort. ex Tan. 'Cleopatra mandarin' × *Poncirus trifoliata*), under varying levels of water deficit. In this investigation, we examined the impact of water stress on the morpho-physiological traits, biochemical responses and adaptive mechanisms of these two rootstocks during 2021-23. The study specifically assesses changes in shoot, leaf, and root architecture, osmo-protectant concentrations, antioxidant activities, and abscisic acid (ABA) levels in plants grown in pots with soilless media under varying water deficit regimes. The results highlight a clear contrast between plant types of the two rootstocks in their response to water deficit. X639 plant types broadly exhibited a highly adaptive, finely-tuned set of responses that enabled it to mitigate the negative effects of water stress. These adaptations include efficient morphological adjustments and increased biochemical defenses, which help conserve water and maintain cellular function under dry conditions. In contrast, *Jatti Khatti* plant types displayed adjustments in morphological traits and physicochemical responses aligned to avoid stress. This rootstock relies more on drought escape strategies, such as reduced growth and early senescence, rather than on adaptive mechanisms that enable it to cope with prolonged drought. These findings provide valuable insights into the resilience and escape mechanisms of citrus rootstocks under water deficit conditions. By understanding how different rootstocks respond to water stress, this



research offers potential strategies for improving citrus cultivation in arid and semi-arid regions, where water availability is a critical concern for sustainable production.

HISTORICAL AND ENVIRONMENTAL DIMENSIONS OF THE SHIMLA HILLS' APPLE BELT IN WESTERN HIMALAYA

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Abstract

The Shimla Hills, often referred to as the “Apple Belt” of Himachal Pradesh, present a fascinating interplay between history and environment, shaping the region’s socio-economic and cultural identity. The introduction of apple cultivation in the early 20th century by Samuel Stokes marked a turning point, transforming the agrarian landscape into a hub of horticulture. This paper explores the historical evolution of apple farming in the region, tracing its roots from colonial times to its current status as a global export center. The unique environmental conditions of the Shimla Hills—characterized by temperate climates, fertile soils, and well-defined altitudinal zones—play a pivotal role in sustaining apple orchards. However, these landscapes are now facing challenges, including climate change, erratic weather patterns, and land-use changes. The paper also examines the socio-economic implications of apple farming, highlighting its impact on livelihoods, regional development, and migration trends. By integrating historical analysis with environmental studies, this work provides a holistic view of how the natural and human-made landscapes of the Shimla Hills co-evolved. It emphasizes the need for sustainable practices to preserve this fragile yet economically vital ecosystem for future generations.

AGRONOMIC MANAGEMENT OF CHICKPEA THROUGH NEW GENERATION HERBICIDES

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Abstract

An experiment was conducted on sandy loam soil of western irrigated plain zone of Rajasthan to find out the most efficient weed management practice to manage the weeds in chickpea using pre and post emergence herbicides. The experiment comprised of 15 treatments and replicated thrice in randomized block design using test variety GNG 2171. The chickpea is a major rabi crop of the zone cultivated on around 3 lac ha and severely affected by major weeds like *Chenopodium album*, *Rumex sp.* and *spergula arvensis*, *Melitous indica*. The humid environment and low temperature during December and January restrict the growth of crop while favour the growth of weeds. Thus a study was conducted to keep the crop weed free for extended period of time. The treatment was applied as per schedule using flat fan nozzle. The treatments are T₁-oxyfluorfen 150 g/ha (PE), T₂-oxyfluorfen 250 g/ha (PE), T₃-quizalofop-ethyl 100 g /ha at 15-20 DAS (PoE), T₄-propaquizafop 100 g/ha at 15-20 DAS (PoE), T₅-topramezone 20.6 g/ha at 14 DAS (PoE), T₆-topramezone 20.6 g/ha at 21 DAS (PoE), T₇-topramezone 20.6 g/ha at 30-31 DAS (PoE), T₈-topramezone 25.7 g/ha at 21 DAS (PoE), T₉-pendimethalin 750 g/ha (PE), T₁₀-oxyfluorfen 150 g/ha fb quizalofop-ethyl 100 g /ha at 15- 20 DAS (PE+PoE), T₁₁-oxyfluorfen 150 g/ha fb propaquizafop 100 g/ha at 15-20 DAS (PE+PoE), T₁₂-oxyfluorfen 150 g /ha fb topramezone 20.6 g/ha at 14-21 DAS (PE+PoE), T₁₃-pendimethalin 750 g/ha fb topramezone 20.6 g/ha at 30-35 DAS (PE+PoE), T₁₄-Weedy check and T₁₅-Weed free check. The mean of two years data reveals that the mean maximum seed yield of chickpea of recorded in treatments pendimethalin 38.7 EC @ 750 g/ha (PE) (18.90 q ha⁻¹) followed by oxyfluorfen 150 g a.i./ha fb quizalofop-p-ethyl 100 g a.i./ha at 15- 20 DAS (18.80 q ha⁻¹) as against the weedy check (11.97 q ha⁻¹). However, the treatment pendimethalin 38.7 EC @ 750 g/ha (PE) recorded highest mean B:C ratio of 2.1 followed by 1.9 in the treatment oxyfluorfen 150 g a.i./ha fb quizalofop-p-ethyl 100 g a.i./ha at 15- 20 DAS. The application of topramezone at various concentrations and at different growth stage caused a severe toxicity as alone as well as in sequence with pre emergence herbicides. However the topramezone recorded maximum weed control efficiency for an extended period of time but initial toxicity on crop followed by low yields and reduced plant growth and yield attributes besides higher cost of cultivation make it unfit for farmers, However further research is required for a meaningful recommendation.



IMPACTS OF ORGANIC INPUTS AND MICROBIAL CONSORTIUM ON GROWTH AND YIELD OF RADISH (*RAPHANUS SATIVUS* L.) CV JAPANESE WHITE

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Abstract

An experiment was carried out on radish (*Raphanus sativus* L.) in Experimental farm, Department of Horticulture, AAU, Jorhat during 2018-2019 and 2019-2020 with the objective to assess the “Impacts of organic inputs and microbial consortium on growth and yield of radish (*Raphanus sativus* L.) cv Japanese white”. The experiment was laid out in RBD with three replications. There were altogether 8 treatments, T₁: (Rock phosphate + Consortium), T₂: T₁ + Compost (2.5 t ha⁻¹), T₃: T₁ + Compost (5 t ha⁻¹), T₄: T₁ + Vermicompost (2.5 t ha⁻¹), T₅: T₁ + Vermicompost (5 t ha⁻¹), T₆: T₁ + Enriched compost (2.5 t ha⁻¹), T₇: T₁ + Enriched compost (5 t ha⁻¹) and T₈: RDF (50:50:100 kg NPK ha⁻¹) + FYM @ 10 t ha⁻¹.

Pooled analysis over two years revealed that the growth and yield attributing characters were significantly influenced by application of different nutrient sources. The mean performance of growth characters revealed that the highest plant height (32.84 cm), maximum number of leaves (16.31), maximum leaf length (24.91 cm), maximum leaf width (7.6 cm) and maximum leaf area index (3.42) was exhibited by treatment T₈ (RDF 50:50:100 kg NPK ha⁻¹) + FYM @ 10 t ha⁻¹ followed by 29.25 cm, 16.0, 22.73 cm, 7.35 cm and 3.35 respectively in T₇: T₁ + Enriched compost (5 t ha⁻¹). Pooled data over two years revealed that the maximum root length (25.45 cm), maximum root diameter (2.715 cm), maximum root weight with top (224.4 g), maximum root weight without top (197.0 g), highest total yield (8.44 kg/plot), maximum percentage of forked roots (2.25 %) and maximum physiological loss in weight (40.42 %) was found in treatment T₈ [(RDF 50:50:100 kg NPK ha⁻¹) + FYM @ 10 t ha⁻¹]. Among organic treatments, maximum root length (24.26 cm), highest root weight with top (190 g), highest total yield (25.41 t ha⁻¹) were found highest in the treatment T₇ (T₁ + Enriched compost (5 t ha⁻¹)). All the growth and yield parameters were significantly poor in T₁: (Rock phosphate + Consortium).

USING NUTRIENT FORTIFIED FARM YARD MANURE TO BIO-STIMULATE INDIAN MUSTARD YIELD AND NUTRIENT AVAILABILITY

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Abstract

Field experiments were conducted during 2016-2021 to assess the impact of graded levels of FYM enriched with micro and secondary nutrients in calcareous soil under rain-fed ecology. The secondary and micro nutrients fortified FYM developed and evaluated its impact to address the issue of decreasing soil health, nutrient availability and yield levels in Indian mustard. FYM @ 10 t ha⁻¹ and FYM (500 kg/ha) fortified with 20 kg S + 5 kg Zn + 2 kg B + 10 kg Fe significantly improved seed yield and growth parameters of mustard. However, highest benefit cost ratio (4.22) with seed yield of 28.72 q ha⁻¹ was obtained under the application half dose of the recommended levels of secondary and micronutrient i.e. 2.5 kg Zn + 1 kg B + 5 kg Fe + 10 g S enriched FYM 500 kg ha⁻¹. It indicated that application of balance amount of micro and secondary nutrients through 500 kg FYM improved mustard yield and economic return to the farmers. Nutrient enrichment with micro and secondary nutrient at the rate of 5.0 kg Zn + 2 kg B + 10 kg Fe + 20 kg S enriched FYM @ 500 kg ha⁻¹ significantly increased the microbial biomass carbon (56.46% SMB-C), SOC (17.13%), and microbial biomass nitrogen (71.14% MBN) over the control. Similarly, nutrient fortification significantly improved the activity of dehydrogenase activity (56.27%), alkaline phosphatase (101.44%) and aryl sulphatase (73.7%) in soil over control. Availability of S, Zn Fe and boron also increased by 17.74, 127.68, 43.41 and 52.76 percent over control. It also aids in maintaining minerals in their naturally chelated state, which improves nutrition over extended periods of time and increases yields. The results showed that the maximum B:C ratio (4.22) was achieved with seed yield of 28.72 q ha⁻¹ when fortified FYM including Zn, Fe, B, and S at the rate of 2.5 kg Zn + 1 kg B + 5 Kg Fe + 10 kg S En- FYM @ 500 kg h⁻¹. Additionally, the single practice of FYM fortification with secondary and micronutrients boosted stover and seed yield by 16.44% and 15.57 percent, respectively, compared to straight application. In



the dry and semi-arid northwest of India, in the states of Rajasthan, Gujarat, Haryana, and portions of Uttar Pradesh and Madhya Pradesh, this research may yield a useful technique for raising mustard production.

EFFECT OF SULFUR-ENRICHED MUNICIPAL SOLID WASTE COMPOST AND CHEMICAL FERTILIZERS ON SULPHUR FRACTIONS AND MUSTARD YIELD

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Abstract

The research aimed to develop sulphur (S) enriched compost using municipal solid waste (MSW) and mustard stover, mixed with locally sources of S waste. A field experiment was conducted with six treatments combinations: T1 (control), T2 (100% recommended dose of chemical fertilizers, RDF), T3 (S enriched compost S1 @ 5 t ha⁻¹), T4 (S enriched compost S2 @ 5 t ha⁻¹), T5 (50% RDF + S enriched compost S1 @ 2.5 t ha⁻¹), and T6 (50% RDF + S enriched compost S2 @ 2.5 t ha⁻¹). Results showed that both S-enriched compost and chemical fertilizers significantly influenced soil organic carbon, soil fertility (in terms of available nutrients), S fractions, and soil microbial properties. The combination of S-enriched compost (S2) @ 2.5 t ha⁻¹ with 50% RDF notably improved various S fractions, including available S, water-soluble S (WSS), HCl-S, and total S (TS), compared to the use of either enriched compost or chemical fertilizers alone. This combination also resulted in a significantly higher sulphur availability index (SAI). Furthermore, soil treated with this integrated approach exhibited a marked increase in arylsulphatase activity (Aryl S) at 217 µg PNP g⁻¹ soil h⁻¹. S-enriched compost (S2) @ 2.5 t ha⁻¹ plus 50% RDF significantly enhanced dehydrogenase activity (17.3 ig TPF g⁻¹ soil h⁻¹) over the use of chemical fertilizers. Additionally, the integration of S2 @ 2.5 t ha⁻¹ with 50% RDF resulted in a significantly higher mustard seed yield (2.83 Mg ha⁻¹) compared to other treatments. Therefore, S enriched compost appears to be a viable, cost-effective alternative for addressing the shortage of water-soluble S fertilizers, promoting sustainable mustard production.

GRADED APPLICATION OF ORGANIC SOURCES AND THEIR EFFECT ON SOIL MICROBIAL POPULATION AND ENZYMATIC ACTIVITIES

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Abstract

The microbial population in soil plays a crucial role in plant nutrient mineralization in most soils. However, the rate at which soil organic matter decomposes is influenced by factors such as soil physico-chemical properties, the presence of other metal ions, soil moisture, and climatic conditions. Soil organisms rely on the carbon content in the soil as their primary food source. In this background, a hypothesis was formulated to examine the effect of organic substances (FYM, Pressmud-PM, Vermicompost-VC) on microbial population in the mustard rhizosphere. A field experiment was conducted with a mustard crop with organic soil amendments comprised with FYM, PM and VC. Different combination of organic substances were applied in nine combinations (T₁-control, T₂-RDF, T₃-RDF+FYM @ 10 t/ha, T₄-RDF+FYM2.5t+PM2.5t/ha, T₅-RDF+ FYM 5 t + PM 5t/ha, T₆-RDF + PM 2.5 t +VC 2.5 t/ha, T₇-RDF+PM5t +VC5t/ha, T₈-RDF +FYM 1.25t+ PM 2.5 t + VC 1.25 t/ha, T₉-RDF + FYM 2.5 t + PM 5 t +VC2.5 t/ha). During the mustard crop growth rhizospheric soil samples were collected and analysed for soil microbial count and enzymatic activities. With the help of different standard analysis methods soil microbial diversity was assessed. The analysis of soil microbial count of bacteria, fungi and actinomycetes population was highest in T9 (RDF + FYM 2.5 t + PM 5 t +VC2.5 t/ha) and lowest in control and RDF treatments. In a similar pattern, soil enzymatic activities DHA, alkaline phosphatase and FDA were reported maximum in highest organic (10 t/ha) applied treatments comprising FYM, PM and VC. These results indicated that combined application of organics through different sources improved the plant nutrient availability in soil, which directly improved the mustard crop yield in low organic carbon containing soils.



EXAMINING THE IMPACT OF NPK FERTILIZATION LEVELS ON GROWTH, YIELD, WATER USE EFFICIENCY AND WATER PRODUCTIVITY OKRA [*ABELMOSCHUS ESCULENTUS* (L.) MOENCH]

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Abstract

A field experiment was conducted at Vegetable Research Centre of G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India during march to june 2022. To examining the impact of NPK Fertilization levels on growth, yield, water use efficiency and water productivity of okra [*Abelmoschus esculentus* (L.) Moench] under open field condition. The experiment was designed in a randomized block design with three replications consisting of seven treatments with each treatment allocated randomly in each plot during testing in open field conditions. Different levels of fertigation applied once in a week according to crop growth curve. Treatment consisting of five fertigation levels viz., T₁: 120 per cent of RDF, T₂: 100 per cent of RDF, T₃: 80 per cent of RDF, T₄: 60 per cent of RDF, T₅: 40 per cent Of RDF. In treatment T₆ 100 per cent RDF was used without using drip and T₇ was without fertilizer application (control).

The findings of present investigation revealed that performance of okra was significantly influenced by different drip fertigation levels. Result suggested that Treatment T₂ (100 per cent of RDF) recorded a significantly higher green pods yield of 142.2q/ha was statistically *at par* with T₁ (135.4q/ha) and significantly better over other treatment during the study. Highest gross return of ₹ 142200.0, net return of ₹86131.75 and B: C ratio of (2.53) was observed in treatment T₂ (100 per cent of RDF). Based on the overall performance, it could be concluded that fertigation at 100 per cent of RDF was the best and most economical treatment recorded in terms of yield kg/plot and yield q/ha. Hence, fertigation of Okra at 100 per cent recommended dose of @100: 80: 80 kg N, P₂O₅ and K₂O/ha is recommended for commercial cultivation of okra.

GENETIC VARIABILITY FOR POD LENGTH AND TEST WEIGHT IN F₃ POPULATION OF FIELD PEA (*PISUM SATIVUM* L.)

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Abstract

Pulses are the backbone of Indian agriculture and play significant role in ensuring human and animal nutrition, soil fertility, environmental sustainability and economic viability. Field pea is one of the important cool season pulse crops grown in many countries. Pea is known for its high seed protein and is consumed in various ways from raw green seeds to whole dried grain dishes. It is one of the preferred sources of vegetable protein especially in vegetarian diet. The seed becomes an important trait as it has distinct consumer preference. In the present study the F₃ population derived from a cross between two contrasting parents viz., IPF 4-9 and Khanapur 10 was evaluated to document the genetic variability for pod length and test weight (100 seed weight). Among the 350 F₃ progenies, the broad range for pod length was evident ranging from 2.64 cm (F-1) to 5.35 cm (F-155) with the mean of 4.12cm. The trait exhibited high heritability (93.50%) with moderate GAM (17.82%), however, GCV (8.93%) and PCV (9.24%) were low. Similarly, there was a significant variability for test weight in the population. The weight of 100 seeds ranged between 5.48g (F-165) and 16.74g (F-239) across the progenies with mean of 11.35g and parental values of 14.54g (IPF 4-9) and 8.08g (Khanapur 10). Test weight recorded moderate GCV and PCV of 15.60 per cent and 15.65 per cent respectively along with high heritability (99.44%) coupled with high GAM of 32.10 per cent. There was no clear trend of association between pod length and test weight indicating the ample variation in among the F₃ progeny families. The population offers high scope of isolating the transgressive segregants for the targeted consumer preferred seed traits. The



progenies having scope for isolation of desired traits will be useful to take forward and identify the trait specific superior genotypes.

A CASE STUDY ON IMPACT OF COUNSELING ON REDUCTION OF BEHAVIORAL PROBLEM AMONG A PRESCHOOLER

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Abstract

During the preschool period, considerable percentage of children will develop the behavioral problems and continue to show these problems during their school age if untreated. Many family, individual and community risk factors like exposure to toxic stressors and parental mental health problems, adverse parenting practices, parental temperament, stress, lack of parental involvement may cause the adverse behavioral problems among preschoolers which may be identified early by using systematic surveillance and proper screening. It is vital that parents must be provided with counseling and education on the condition of their child has and the services available to help both the child and the family. In the present study, quan-qual research method was employed where; the ASEBA child behavior checklist was employed on a parent to assess the child's specific behavioral problems while Parenting Relationship Questionnaire was used to assess the parenting practices. To measure the parental temperament, Adult Temperament Questionnaire was used. The qualitative research methods with phenomenology, case study and narrative analysis were employed to know the impact of the counseling provided for the parent to reduce the behavioral problems among preschool child. The in-depth interviews were carried out with the parents to know their lived experiences in managing the children with behavioral problems/disorders. The case reported in the present study was identified with the internalizing behavioral problems viz., withdrawn behavior, shyness, fear, being alone, sad, stranger anxiety and timid behavior more apparent at home in absence of father. In the four counseling sessions with the parents and a child, play therapy, sand therapy and parent child interaction therapies were adopted to improve their communication and relationship. The reliable change index showed that the child's total behavioral problem and internalizing behavioral problems were decreased reliably from first session to follow-up session and also there is an improvement in parenting practices, attachment and involvement. This indicated that, counseling helped mother to focus on pleasant emotions and also helped to reduce the child's internalizing behavioral problems.

BIO EFFICACY OF NOVEL INSECTICIDE AGAINST CHICKPEA POD BORER, *HELICOVERPA ARMIGERA* (HUBNER)

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Abstract

Pulses are an important group of food crops that, due to their high protein content, hold a unique position in agriculture. Chickpea (*Cicer arietinum* L.) also known as Bengal Gram or chana is an important Rabi pulse crop in India. It originated in south-western Asia. This is known as the "King of Pulses" (Bhatt and Patel, 2001). In Rajasthan, the annual losses caused by *H. armigera* to the chickpea crop have been estimated to be around 2030 million (Annonymus 1996). During its life, a single larva can damage 30-40 pods and under congenial weather conditions this pest can cause up to 80% crop loss. Massive application of pesticides not only leave harmful residues in the food chain but also causes harmful effect on non-target organism and environment, causes pest resurgence and development of resistance in insect to insecticides. The bio efficacy of novel insecticide Flubendiamide (39.35% SC) against chickpea pod borer, *Helicoverpa armigera* was assessed through on farm trial at multi locations during rabi 2019-20 and 2020-21. The mean larval population of *H. armigera* at vegetative and pod formation stage was comparatively less (2.28, 3.87) in T1 (Pheromone traps @ 5-6/ha and Flubendiamide 39.35% SC) during both the year. Similarly, T1 also registered lower pod damage (5.01%) as compared to farmers practices (7.56%). Application of Flubendiamide 39.35% SC provide higher seed yield (16.99) and mean net return (64182/). Incremental benefit cost ration was higher in T1 (3.09) as compared to T2 (2.68).



OCCURRENCE AND DISPERSAL OF SCLEROTINIA ROT OF CHICKPEA INCITED BY *SCLEROTINIA SCLEROTIUM* IN RAJASTHAN

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Abstract

Chickpea is one of the major legume crops cultivated in India. Sclerotinia rot or white rot of chickpea caused by *Sclerotinia sclerotiorum* (Lib.) de Bary has become a serious problem in recent years in major chickpea growing areas of Rajasthan and other chickpea growing parts of India. A roving survey was conducted during Rabi 2016-17 and 2017-18 in major chickpea growing districts of Rajasthan revealed that Sclerotinia rot was a major problem in Sri Ganganagar (19.95%), Hanumangarh (19.04%), Kota (18.55%), Sawaimadhopur (17.84%) and Bikaner (16.53%) districts. The maximum disease incidence was observed on the collar region, stem, and foliage leading to mortality of the plants. With the progress of the disease, a white web of mycelium and Sclerotia were seen on invaded parts giving its particular diagnostic symptoms. The infected plants were found scattered in the field during February and March.

BIOCHEMICAL EVALUATION OF TOMATO (*SOLANUM ESCULANTUM* L.) VARIETIES AVAILABLE IN THE UTTAR PRADESH REGION

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Abstract

Vegetables are important component of balanced human diet. Advanced production technologies are being followed to measure productivity and quality of produce. Tomato occupies a prime position in list of protective vegetable fruits since it is a rich source of minerals, vitamins and organic acids. Tomato fruit contains high moisture and dry matter (DM) of 5-7.5%. The composition of dry matter in tomato consists of sugars, mainly glucose and fructose, organic acids (citric and malic acid); minerals, (N, P and K), vitamins and antioxidant pigments such as lycopene; they have beneficial effects on human health, reported that the consumption of the tomato and its products (i.e., ketchup, paste) is negatively correlated with the development of tumours in the digestive tract and prostate cancer. -carotene is known for its provitamin A activity and lutein for reduced risk of lung cancer. Vitamin C plays an important role in human health and its main functions are in the prevention of scurvy and maintenance of skin and blood vessels (Lee and Kader, 2000). Besides its importance for consumption, fruit acidity and total soluble solid content are vital factors in the processing industry. The acidity is related to pH and low pH of the pulp prevents the growth of microorganisms that are harmful, which in turn decreases the period of heating needed for sterilisation during processing. The antioxidant content of tomato mostly depends on both genetic and environmental factors and the ripening stage reported that tomatoes contribute to a wellbalanced healthy diet with the right proportion of vital nutrients such as minerals, vitamins, essential amino acids, sugars, lycopene and other carotenoids and dietary fibres. Tomato being acceptable to people as a food could be a source of nutrients as well as a nutraceutical in the sub-continent. Therefore present experiment was carried out to study biochemical composition of different genotypes of tomato.

PHYSIOLOGICAL RESPONSE DURING ACUTE HEAT STRESS IN COLDWATER FISH SPECIES *TOR PUTITORA*

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Abstract

Increasing global temperature is a significant threat to aquatic ecosystems, leading to considerable losses in aquaculture. The



present study explored the physiological response of coldwater aquaculture species *Tor putitora* under acute heat stress. Fish were exposed to two temperature conditions, 22°C as the control and 32°C to simulate heat stress. Oxidative stress parameters i.e. superoxide dismutase (SOD), catalase (CAT), glutathione reductase (GR) activity, malonaldehyde (MDA) content, and histological alterations in the gills, liver, kidney, spleen, and intestine were recorded in both groups. The antioxidative enzyme activities i.e. SOD, CAT, and GR were found low in heat-stress fishes compared to the control. However, MDA content was found high in the treatment group. The gill tissues displayed signs of lamellar fusion and degeneration. Other examined tissues also showed severe histological alterations. This investigation highlights the detrimental impact of thermal stress on the overall physiology of *T. putitora*. The findings provide essential insights into the physiological mechanism involved in the species' stress response, emphasizing the need to adopt adaptive strategies for coldwater aquaculture species. As climate change continues to drive temperature variability, these results are pivotal for designing interventions aimed at improving the resilience and sustainability of economically important aquatic species.

COMPARATIVE ANALYSIS OF DROUGHT STRESS TOLERANCE IN BREAD WHEAT AND SPELT WHEAT

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Abstract

A field experiment was conducted to evaluate the morphological and physiological responses of bread wheat and spelt wheat to drought stress, a major limiting factor for wheat production that profoundly impacts traits associated with drought tolerance. This investigation focused on three wheat genotypes—WH 1080, British Spelt, and Romanian Spelt—by analyzing their morphological characteristics (including plant height, number of spikes per plant, spike length, spike weight, and 100-grain weight) and physiological parameters (chlorophyll content, relative leaf water content (RLWC), water use efficiency (WUE), and relative stress injury (RSI)) under both controlled and drought-stressed conditions. The results revealed that drought stress substantially impaired all genotypes, reducing grain weight, spike attributes, and plant height. WH 1080 exhibited the highest sensitivity, with marked declines in chlorophyll content, RLWC, and spike weight, along with a significant elevation in RSI, reflecting increased cellular damage. Conversely, British Spelt demonstrated superior drought resilience by retaining higher chlorophyll content, RLWC, and WUE under water-limited conditions, coupled with a relatively lower increase in RSI, indicating enhanced membrane stability. Romanian Spelt exhibited intermediate responses, with moderate reductions in chlorophyll content and RLWC but a stable WUE and comparatively higher RSI than British Spelt. Overall, British Spelt emerged as the most drought-resilient genotype, maintaining superior water retention, efficient photosynthetic activity, and minimized stress-induced injury under drought conditions. These findings underscore British Spelt's potential for cultivation in drought-prone regions and emphasize the need for further exploration of its drought tolerance mechanisms to inform breeding strategies aimed at enhancing wheat resilience to water stress.

MOISTURE CONSERVATION IN PEARL MILLET [*Pennisetum glaucum* (L.) R. Br.] THROUGH SUPER ABSORBENT POLYMERS AND CROP RESIDUES UNDER DRYLAND CONDITIONS OF RAJASTHAN IN INDIA

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Abstract

Farmers' in dryland areas of the India especially in western Rajasthan, parts of Haryana and some parts of Gujarat extremely faced the drought condition during the crop season and that is the major reason that the farming in these areas are wholly depends on the monsoon rains during *kharif* season. Hence moisture conservation and utilization is main priority during the



crop period. The present experiment was conducted at ICAR-All India Coordinated Research Project on Pearl Millet, Mandor during rainy seasons of 2020, 2021 and 2022. The experiment consisting of ten different super absorbent polymers (hydrogel) and crop residue mulching treatments i.e. T₁: Control (RDF), T₂: T₁+Crop residue mulch @ 5.0 t/ha after 10-15 DAS, T₃: T₁+ Pusa Hydrogel dry application @ 5.0 kg/ha, T₄: T₁+ SPG 1118 dry application @ 5.0 kg/ha, T₅: T₁+ Pusa Hydrogel slurry application @ 5.0 kg/ha, T₆: T₁+ SPG 1118 slurry application @ 5.0 kg/ha, T₇: T₃+ Crop residue mulch @ 5.0 t/ha after 10-15 DAS and T₈: T₄+ Crop residue mulch @ 5.0 t/ha after 10-15 DAS, T₉: T₅+ Crop residue mulch @ 5.0 t/ha after 10-15 DAS and T₁₀: T₆+ Crop residue mulch @ 5.0 t/ha after 10-15 DAS with replicated thrice in randomized block design. It is revealed from the data (2020-2022) of Mandor and Bikaner that the treatment T₈ (RDF+ SPG 1118 dry application @ 5.0 kg/ha + Crop residue mulch @ 5.0 t/ha after 10-15 DAS) was found superior in terms of grain and stover yield (23.02 and 43.37 q/ha, respectively) as compared to all the remaining treatments including control (14.71 q/ha grain; 31.22 q/ha stover). The grain and stover yield were improved to the tune of 56.5 and 38.9% in the T₈ treatment over the control. However, the maximum B:C ratio of 2.84 was recorded in the T₅ (T₁+ Pusa Hydrogel slurry application @ 5.0 kg/ha).

STUDYING THE CHANGES IN ANTHOCYANIN DEGRADATION, ION LEAKAGE AND MALONDIALDEHYDE IN THE AGEING PETALS OF CUT GERBERA (*GERBERA JAMESONII* BOLUS) CVS STANZA AND ROSALIN*

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Abstract

Gerbera (*Gerbera jamesonii* Bolus), is a well-known commercial cut flower ranking fourth in the global market. Shorter vase life and poor quality have been one of the major issues for gerbera export along with the physiological disorder stem bending of the flower stalk which is alternately called scape or neck bending. Stem bending is assumed to be the primary cause of hindrance of cut stem water uptake in gerbera cultivars that occurs before wilting of the ray florets, which ultimately reduces the vase life. The present investigation entitled studying the changes in anthocyanin degradation, ion leakage and malondialdehyde in the ageing petals, during stem bending of cut gerbera (*Gerbera jamesonii* Bolus) cvs Stanza and Rosalin were carried in the laboratory, Department of Floriculture and Landscaping, Bidhan Chandra Krishi Viswavidyalaya during the year 2021-2022. The results of the present study showed that anthocyanin content in the petals was recorded highest at no bending stage in both the cultivars and declined further till full bending stage. The highest anthocyanin (3.56 mg/g FW) was noted in cv Stanza at no bending stage. Whereas the ion leakage and malondialdehyde content gradually increased in both the cultivars as the senescence progressed to full bending stage from no bending stage. The highest ion leakage (78.32%) was noted in cv Rosalin at full bending stage and the highest malondialdehyde (323.51 nmol.mL⁻¹) was noted in cv Stanza at the full bending stage.

AUSPICIOUS TEMPERATURE AND PH FOR DEVELOPMENT OF *SCLEROTIUM ROLFSSII* OF LENTIL (*LENS CULINARIS* L.)

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Abstract

Lentil (*Lens culinaris* L.) is an edible pulse. It is a bushy annual plant of the legume family. Sprouted lentils contain sufficient levels of all essential amino acids, including methionine and cysteine. Lentils also contain dietary fiber, folate, vitamin B1, and minerals. Red (or pink) lentils contain a lower concentration of fiber than green lentils (11% rather than 31%). Productivity of lentil is reduced due to different diseases infecting leaves, stems, roots and pods. It also reduces marketability due to discoloration of seeds. Among all the diseases of lentil, collar rot or root rot is most destructive disease which is caused by *S. rolfssii*. It causes yield losses up to 50%. *Sclerotium rolfssii* Sacc. is a soil-borne pathogen that commonly occurs in the tropics, sub-tropics and other warm temperate regions. The characteristic symptoms include white fungal strands (mycelia or hyphae)



around collar region of the infected plant parts and on the soil surrounding the plant were observed during field study. Experiment was conducted on various temperature i.e. 15, 20, 25, 30 and 35°C under research laboratory condition and result revealed that 25° C give maximum mycelium growth and number of Sclerotia which was at par with 30 °C after 4 days of incubation. In pH study maximum mycelium growth was observed on 6.5, 7.0 and 7.5 at 7 days.

INNOVATIONS IN PEARL MILLET BREEDING FOR ENHANCED YIELD STABILITY: STRATEGIES, ACHIEVEMENTS, AND PERSPECTIVES

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Abstract

Pearl millet is cultivated under the most adverse agro-climatic conditions challenged by low and erratic rainfall, high mean temperature, high potential evaporation, and infertile and shallow soils with poor water holding capacity resulting in the huge temporal and spatial variation in its productivity and unstable production. The objective of this chapter is to review the strategies for achieving higher productivity and greater stability in India and Africa and to suggest future approaches and necessary interventions in pearl millet breeding meet the forthcoming challenges to provide higher and stable yields. The major strategies for enhancing yield included strategic use of germplasm resources and cultivar development (mostly hybrids) with targeted traits as per the requirement of production ecologies. On the other hand, the approach to augmenting stability has been improving genetic resistance to diseases, increasing tolerance to abiotic stresses, and addressing regional adaptation. Following the adoption of high-yielding, disease-resistant and drought-tolerant cultivars and crop production technology, pearl millet productivity has been consistently increasing in India. In view of increasing demand of pearl millet grain and stover in future, the higher yields are to be targeted. Pearl millet cultivation is likely to become more challenging because of predicted intense drought stress, rise in temperature, and greater disease incidences in sub-Sahara Africa and South Asia; yields must be increased at a much faster rate with greater stability in challenging agro-ecologies. Speed breeding and molecular-marker assisted breeding are going to play a very important role to enhance genetic gains in future. Mainstreaming the bio-fortification is essentially needed to amalgamate higher productivity with nutritional traits to address both energy and micronutrient malnutrition issues.

EVALUATION OF SEEDLING PRODUCTION TECHNIQUES IN BRINJAL

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Abstract

Brinjal (*Solanum melongena* L.) is one of the most important solanaceous crop grown for its edible fruits. It contributes substantially in providing food and nutritional security and contains high amount of fibre, vitamins (Vitamin A, C) and minerals. It is one of the most important and widely cultivated crops in S.A.S. Nagar (Mohali) district of Punjab. It is grown in many parts of district during different seasons in year and farmers fetch good returns from its sale. The present investigation involves evaluation of seedling production techniques in brinjal. To evaluate best seedling production technique, an On Farm Trial (OFT) was conducted by K.V.K. S.A.S. Nagar (Mohali) in farmer's field during 2022-23. The present on farm trial was conducted in five farmer's field to evaluate different seedling production techniques in brinjal. The treatment comprises: T₁: Farmer practice, T₂: Seedling production from the raised nursery bed (line sown + Seed treatment with *Pseudomonas fluorescens* @ 10 g/kg of seed) at 15 cm raised bed and cover with sand & T₃: Seedling production from the pro-tray (Tray medium: Cocopeat + Vermiculite+ perlite) + Seed treatment with *Pseudomonas fluorescens* @ 10 g/kg of seed) under shade nets. Observations were taken on various growth, yield and economic parameters. Selected farmers were trained on scientific raising of nursery and crop including intercultural operations, nutrient management, water management, weed management and proper harvesting and postharvest handling through on and off campus trainings. Seedling and crop was raised following recommended package of practices. The results of the study revealed that T₃ recorded maximum seedling germination (92.14),



maximum plant height (10.05 cm), maximum seedling girth (0.16 cm), maximum number of leaves per seedling (5.80), percent of healthy seedlings (90.80) and maximum yield (220.60 per acre) followed by T₂ and T₁. Treatment T₃ recorded 15.80 % increase in yield over check while T₂ recorded 7.09 % increase in yield over check. Maximum BC ratio was recorded in T₃ (3.51) followed by T₂ (3.05) and T₁ (2.95).

EXPLORING THE PHYLLOSHERE BACTERIA FOR PLANT GROWTH PROMOTION IN SELECTED SOLANACEOUS CROPS

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Abstract

Methylobacterium species, also known as pink-pigmented facultative methylotrophs (PPFMs), are bacteria that can grow on single-carbon compounds like formate, formaldehyde, and methanol, as well as various multi-carbon compounds. They are widely distributed in the plant phyllosphere and rhizosphere and have been isolated from numerous plant species. Methylotrophs are recognized for their important role in enhancing crop yield and soil fertility. The present investigation envisages isolation, characterization and evaluation of Pink Pigmented Facultative Methylotrophs (PPFMs) associated with Solanaceous crops. Pink Pigmented Facultative Methylotrophs (PPFMs) were isolated from the phyllosphere of solanaceous crops like tomato, potato, chillies and brinjal collected from different locations of Mau and Azamgarh districts of Uttar Pradesh by leaf imprint method using Ammonium Mineral Salt (AMS) agar media supplemented with 0.5% methanol and cycloheximide. A total of 40 isolates were obtained. They were tentatively identified as PPFMs based on the characteristic pink pigmented colonies on AMS agar media with methanol as sole source of carbon and energy. Further, these isolates were identified using 16s rRNA gene sequence. All the 40 PPFM isolates including reference culture were found to produce IAA under in vitro conditions. However, it showed wide variations ranging from 0.1 to 2.1 µg/ml µg mL⁻¹ without supplementation of tryptophan and from 12.04 to 68.01 µg/ml µg mL⁻¹ of culture filtrate under tryptophan supplementation. Seed germination test showed that three isolates namely PPFM 14, 32 and 38 showed better performance. Among these three isolates, *Methylobacterium populi* (PPFM32) showed the maximum *acc deaminase* activity. To study the plant growth promoting ability of PPFM isolates, a pot culture study was carried out. The results obtained from three plants under pot conditions have revealed that the treatment T4 i.e. consortium of PPFM 14+32+38 showed comparatively higher properties of plant growth promotion such as plant height, dry biomass, chlorophyll, antioxidant and total phenol content. Hence, it can be concluded that the strains of PPFM exhibited symbiotic relationship when exist together which ultimately resulted in promotion of crop growth as compared to their individual inoculation.

BIORATIONAL MANAGEMENT OF TOMATO FRUIT BORER *HELICOVERPA ARMIGERA* IN WESTERN RAJASTHAN

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Abstract

A Field experiment was conducted to evaluate different biopesticides for the management of tomato fruit borer *Helicoverpa armigera* at Dr. BRC Agricultural Research Station, Mandor Agriculture University Jodhpur during the year Rabi 2022-23 and 2023-24. The application of various treatments i.e. Spinosad 45SC @ 0.5 ml/lit, Azadiractin 3000 ppm @ 3 ml/lit, BARC Bt @ 1.4 g/lit, Dipel @ 2 ml/lit, *Beauveria bassiana* @ 3 g/lit, Emamectin benzoate @ 0.4 g/lit and control against the tomato fruit borer. All the treatments were found significantly superior in reduction of *Helicoverpa* over control. Pooled data revealed that Emamectin benzoate @ 0.4g/lit was found most effective with minimum *Helicoverpa* population 0.92,0.81 & 0.88,0.80 per plant at 7 DAS and 10 DAS after first and second spray respectively followed by spinosad 45sc @ 0.5 ml/lit (1.09,1.01 & 1.05,0.95 per plant) and it was at par with BARC Bt(1.04,1.02 & 0.98,1.03 per plant) & Dipel (1.07,1.06 & 1.03,0.92). Application of *Beauveria bassiana* @ 3g/lit was observed as next effective treatment with *Helicoverpa*



population of 1.18, 1.08 & 1.14, 1.06 per plant at 7 DAS and 10 DAS after first and second spray respectively and it was at par with Azadiractin 3000 ppm @ 3 ml/lit (1.50, 1.47 & 1.46, 1.41 per plant at 7DAS and 10DAS after first and second spray). Maximum yield (47.67 q/ha) was recorded in the Emamectin benzoate followed by spinosad (44.0 q/ha), BARC Bt (42.02 q/ha) and Dipel (41.17 q/ha).

STUDY OF SOCIO-ECONOMIC STATUS OF MEMBERS OF FISHERIES CO-OPERATIVE SOCIETIES OF KISHANGANJ DISTRICT OF BIHAR

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Abstract

The evaluation of socio-economic status is the prerequisite to formulate the policies for the upliftment of livelihood. The present study deals with the members of fisheries cooperative societies of Kishanganj district of Bihar. Pre-structured interview schedule was used to collect the data. There are 6 fisheries cooperative societies working in the district. For the present study all 6 fisheries cooperative societies were selected. Further a total of 30 members from each society and all together 180 respondents were randomly selected. In the selected societies "Kochadhaman Prakhanda Matsyji Sahyog Samiti" was the largest society with 1468 members. It was also noticed that there was almost equal proportion of population of old age members and young members. Further, the percentage of BC category members in the society was highest (69.44%) and majority (70%) were illiterate to functionally literate. Composite fish culture and Makhana cum fish culture was the main occupation of the society. The study showed that only 2.78 percent respondents had annual income from 1 to 2 lakhs from fisheries activity. Majority of the respondents (93.89%) were using mobile phone but only 29.44 percent respondents were using internet. For this study it was noticed that only 2.22 percent respondents had boat & 95.56 percent had net to catch fish. Study revealed that more than half (54.44%) of the respondents did not avail any benefit of government schemes. The information collected from the study will help the policy makers for formulation of location and target specific strategy for socio-economic upliftment.

CORRELATION AND PATH ANALYSIS IN GROUNDNUT (*ARACHIS HYPOGAEA* L.)

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Abstract

Groundnut (*Arachis hypogaea* L.) is an important food, feed and oilseed crop. It contains 48-50% oil and 26-28% protein, and is a rich source of dietary fiber, minerals, and vitamins. It is grown in nearly 100 countries. Major groundnut producers in the world are: China, India, Nigeria, USA, Indonesia and Sudan. Groundnut is gaining importance as a food crop, on account of high digestible proteins, vitamins, minerals, phytosterols and due to increased consumer preference after value addition. Over 100 countries worldwide grow groundnut. Developing countries constitute 97% of the global area and 94% of the global production of this crop. The production of groundnut is concentrated in Asia and Africa (56% and 40% of the global area and 68% and 25% of the global production, respectively). In India, the area, production and productivity of groundnut during 2022-23 were 49.612 lakh hectares, 102.967 lakh tones and 2075 kg ha⁻¹, respectively. While in Rajasthan, the area, production and productivity of groundnut during 2022-23 were 8.048 lakh hectares, 19.318 lakh tones and 2400 kg ha⁻¹, respectively. There is a need to identify high yielding groundnut genotypes which will be useful and economic to farmers of the area. Hence, keeping in view, the field experiments were conducted during Kharif, 2022 and 2023 at Instructional Farm, CTAE (MPUAT), Udaipur.

Among the tested entries viz., UG 210 gave maximum mean dry pod yield (4167 Kg/ha) followed by other entries and significantly superior over all the checks viz., Dh 86 (3414 kg ha⁻¹), TAG 24 (3356 kg ha⁻¹), TG 37 A (3299 kg ha⁻¹), JL 776 (3183 kg ha⁻¹) and Pratap Mungphali-3 (2894 kg ha⁻¹). Kernel yield was ranged from 2019-2988 kg ha⁻¹. The shelling out-turns of different entries ranged from 69-72%, sound mature kernels were ranged from 91-96 percent, 100-kernel weight ranged between 44-63g. The days to maturity ranged from 108-112 days.



MUSHROOMS : RESERVOIR OF VITAL NUTRIENTS AND BIOACTIVES

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Abstract

Human need a wide range of nutrients to lead a healthy and active life, which could only be derived a well- balanced diet. Edible mushrooms do not only add to culinary delicacies of Indian platter but are also rich source of nutrients and bioactives that can render specific health benefits to consumers. Some of the biomolecules of mushrooms are known to be potent antioxidants, immune-modulators, cholesterol inhibitors etc. Besides these bioactives having specific metabolic actions, macro-nutrient composition of mushrooms is in such proportion that if can provide specific diet benefits to the consumers and also targeted against the prevalent lifestyle disorders. Five major nutrients in food are carbohydrates (CHO), proteins, fats, minerals and vitamins. A balanced proportion of these if consumed is known to be a balanced diet. All food materials are composed of these five principal constituents in various proportions including mushrooms. Mushrooms have nearly 90% water with only 10% of solid matter. Out of this solid matter 40-70% is carbohydrates and 10-40% is protein, mushrooms contain very little fat ranging from less than 1-6%. The balance of complex carbohydrates and simple proteins with low fat and high mineral content make mushrooms an ideal food for the masses. Medicinal mushrooms are also very important and extraction of specific bio-active compounds having medicinal and functional properties for the development of nutraceuticals can go a long way in improving the health status of society and fighting against mortality due to lifestyle diseases.

SYNTHESIS AND CHARACTERIZATION OF BIO-NANOCOMPOSITES DERIVED FROM AGROWASTE WITH THE INTEGRATION OF NANOPARTICLES

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Abstract

There has been the significant advancement in development of antimicrobial polymer nanocomposites (ANCs) from renewable resources. The utilization of agro waste based renewable resources makes it possible for to replace petroleum-based polymer materials. The present study demonstrates a viable method of utilization of groundnut and walnut as potential renewable resource for development of ANCs through integration with copper oxide nanoparticles (CNPs). The synthesized ANCs were examined by X-Ray Diffraction, Fourier transform infrared spectroscopy and scanning electron microscopy. The ANCs has been investigated for their antibacterial activity against *Escherichia coli* through agar well diffusion method. CNPs infused discs of ANCs were prepared and placed over the bacterial spread plates followed by incubation overnight at 37 °C. then observed zone of inhibition was measured in mm against the E. coli bacteria. The percentage of inhibition zones of ANCs against E. coli were 66.6%, 72.72% and 74.65%. Antibacterial activity of ANCs increased with an increase in concentration of CNPs in polymer nanocomposite.

INTEGRATED MANAGEMENT OF DIAMONDBACK MOTH, *PLUTELLA XYLOSTELLA* IN CABBAGE IN SOUTH EASTERN PLATEAU REGION OF JHARKHAND (SUB ZONE VI)

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Abstract

A field experiment was conducted during rabi 2023-24 on “Integrated management of Diamondback moth (DBM), *Plutella xylostella* in cabbage in South Eastern Plateau region of Jharkhand (Sub Zone VI)” at Zonal Research Station, Darisai, East Singhbhum in a Randomized Block Design with three replications and eight treatments. All the treatments recorded



significantly superior over control. The treatment foliar spray of NSKE 5 % in combination with *Spinosad* 2.5 SC @ 0.6 ml/L, 3 foliar sprays, 1st at 30 days after transplanting (DAT), 2nd at 45 DAT and 3rd at 60 DAT found the best treatment for management of DBM in cabbage in *Rabi* season, which produced the highest healthy and fresh marketable yield of cabbage (598.00 q/ha) and received the lowest incidence by the larvae and pupae of DBM (0.68 No. of larvae and pupae/plant) at 60 DAT and also recorded the maximum percent reduction (94.36 %) over control followed by the treatment application of NSKE 5 % in combination with Flubendiamide 20 % WG @ 2 g/L, which produced healthy and fresh marketable yield of cabbage (554.58 q/ha) and received the incidence by the DBM (0.86 No. of larvae and pupae/plant) with percent reduction (92.86 %) over control at 60 DAT and both the treatments were at par with each other. While the control plot received the highest population of DBM (12.06 No. of larvae and pupae/plant) and produced the lowest and unhealthy yield of cabbage (312.30 q/ha). This technology may be recommended for successful management of DBM in cabbage in Jharkhand.

DE NOVO DOMESTICATION FOR CROP IMPROVEMENT

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Abstract

Crop domestication refers to evolution of wild plants into the cultivated with the help of human interventions. Crop domestication acts against the natural selection where negative correlation of the alleles with their environment are overcome through man made selection. This crop domestication coupled with artificial selection led to the today's modern cultivars with higher productivity wide spreading throughout the world. But, in this domestication process, some valuable alleles which were evolved to provide tolerance against biotic and abiotic stresses lost also leading to the narrowing down genetic diversity of major crops. To overcome this bottleneck of crop domestication and artificial selection, de novo domestication of wild plants can serve as better alternate of ordinary crop domestication to tailor the future crops and to ensure the food security to this ever growing population with more sustainable approach. De novo domestication is a process where domesticated genes are incorporated into the non-domesticated species to develop genetically altered new crops or cultivars to meet the current human and climatic needs. It is performed by scientist as well as farmers, and can be done through traditional selective breeding or modern biotechnological methods. De novo domestication can play a crucial role to improve the diversified ecosystem, to enable the crops to sustain under adverse or stressful climatic conditions and to gain in the genetic diversity. The first pre requisite for de-novo domestication is to identify the key important genes from Crop Wild Relatives (CWRs) by using high-throughput approaches. Identification and domestication of monogenic traits is comparatively easy in nature as compared to polygenic traits such as abiotic stress tolerance traits which are very tough to exploit. Target crops for de novo domestication are species that have never been under cultivation or wild relatives of domesticated species. De-novo domestication strategy may offer quick and accurate modifications of CWRs into cultivated crops, while preserving most of the beneficial alleles controlling stress resilience, important agronomic and nutritional traits, disappeared during breeding.

GENETIC VARIABILITY FOR YIELD AND QUALITY CHARACTERS IN CHICKPEA (*CICER ARIETINUM* L.) UNDER RICE BASED CROPPING SYSTEM.

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Abstract

The experimental material comprised seven lines viz., Vaibhav, Indira Chana-1, JG 315, JG 11, JG 14, JG 16, JG 130 of agronomic base and three testers JG 97, ICCV 96029 and ICCV 96030 for early maturity were crossed as per Line x Tester mating design fashion to develop 21 F₁s during, *Rabi* 2014-15. These F₁s along with their parents were evaluated two replications in one row plot during. Under following rice based cropping system viz. E₁: CS-I, E₂: CS-II, and E₃: CS-III. The row to row and plant to plant spacing 30 x 10 cm maintained at Research cum Instructional farm, Department of Genetics and



Plant Breeding, Indira Gandhi Krishi Vishwavidyalaya, Raipur. The PCV was higher in magnitude than its corresponding GCV for all the characters under study. This indicated the influence of the environment on the expression of these characters. The high values of phenotypic coefficients of variation were recorded for secondary branches plant⁻¹, pod plant⁻¹, hydration index, seed yield plant⁻¹, hydration capacity seed⁻¹, biological yield, primary branches plant⁻¹, Swelling index in all three environments E₁, E₂ and E₃. High heritability estimates coupled with high genetic advance were found for the characters plant height⁻¹, primary branches plant⁻¹, secondary branches, plant⁻¹, pods plant⁻¹, biological yield plant⁻¹, 100-seed weight, seed yield plant⁻¹, seed volume, hydration capacity seed⁻¹, hydration index and swelling index all three environments E₁, E₂ and E₃ indicated the role of additive genetic variance in the expression of these characters. Rest of the characters were having moderate to low heritability coupled in high to low genetic advance as percentage of mean indicated the role of non additive genetic component in their expression.

CURCUMIN ON SEMEN QUALITY ATTRIBUTES IN LIQUID STORED SEMEN OF ENDANGERED TERESSA GOAT OF ANDAMAN AND NICOBAR ISLANDS, INDIA

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Abstract

Curcumin in semen extender on semen quality parameters in Teresa buck was assessed. A total of 25 semen samples from six bucks were selected for the study. Spermatozoa of $4 \times 10^8/\text{mL}$ were incubated in 1 mM, 2 mM and 4 mM of curcumin as Gr II, III and IV, respectively. Liquid stored semen samples were analysed for motility, viability, total sperm abnormality, plasma membrane, acrosomal and nuclear integrities, intracellular enzymes (aspartate aminotransferase; AST, alanine aminotransferase; ALT and lactate dehydrogenase; LDH), cholesterol efflux, seminal total antioxidant capacity (TAC) and malondialdehyde (MDA) in comparison with control group (Gr I) for upto 72 h. Results revealed that curcumin (2 mM) treated semen had significantly ($P < 0.05$) higher motility, viability, plasma membrane, acrosomal and nuclear integrities and TAC and had significantly ($P < 0.05$) lower total sperm abnormalities, AST, ALT, LDH, MDA and cholesterol efflux compared to those in other curcumin treated and control groups at different hours of liquid storage. Semen quality parameters and antioxidants were showing increasing trend and total sperm abnormalities, MDA, leakage of intra-cellular enzymes and cholesterol efflux were showing decreasing trend from Gr I to Gr III and then opposite trends from Gr III to Gr IV at different hours of liquid storage. Thus, 2 mM curcumin was a suitable dose for liquid semen preservation in Teresa goat.

EFFECT OF MICRONUTRIENT ON GRAIN & STRAW YIELD OF WHEAT IN WHEAT-GUAR CROP SEQUENCE UNDER LOAMY SAND SOIL OF ZONE IIIA OF RAJASTHAN

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Abstract

A field experiment was conducted at RARI, Durgapura, Jaipur in irrigated coarse textured agro ecological micro farming situations during Rabi 2013-14, 2014-15 & 2015-16 to find out the effect of micronutrient application on grain and straw yield of wheat in wheat- guar cropping sequence. Eight treatments were taken in randomized block design with three replication variety Raj- 3765 of wheat was taken as test crop. Three years data revealed that soil application of FeSO_4 @ 50 kg/ha gave significantly higher grain and straw yield (35.67 & 46.38 q/ha) in first year, (36.67 & 53.50 q/ha) in second year and (37.92 & 54.58 q/ha) in third year of wheat over T₁ where, only recommended dose of NPK was applied. The lowest yield was recorded in T₁ (29.92 & 38.66 q/ha) in first year, (30.50 & 45.03 q/ha) in second year and (32.58 & 46.27 q/ha) in third year. All the treatments where, iron was combined with other micronutrients gave significantly higher grain and straw yield of wheat, but at par with iron alone i.e. T₃. There was no response of zinc and manganese alone and their combination with each other due to higher initial status of zinc and manganese in soil. (Above the critical limit i.e. 0.6 and 2.0 mg/kg). Initial Status was for Zn: 1.80, for Fe: 2.86 and for Mn: 7.9 mg/kg.



POST-HARVEST MELATONIN APPLICATION MAINTAINS FRESHNESS AND EXTENDS SHELF-LIFE IN INDIAN JUJUBE (*ZIZIPHUS MAURITIANA* LAMK) FRUITS

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Abstract

Indian jujube (*Ziziphus mauritiana* Lamk) is a highly perishable climacteric fruit with a short shelf life of only 3–4 days under ambient storage conditions. This limited durability is attributed to its rapid ripening, high respiration rate, and intense metabolic activity. Additionally, the prevailing high temperatures and low relative humidity during the harvest season exacerbate challenges, leading to significant water loss, shrinkage, softening, and peel browning. These factors collectively diminish the fruit's market value. To preserve its quality during post-harvest storage and marketing, Indian jujube requires special attention and appropriate handling practices. Melatonin, scientifically identified as N-acetyl-5-methoxytryptamine, is a versatile indole compound present in a wide range of biological organisms. It is integral to various physiological processes, including growth, development, fruit ripening, senescence, and adaptation to biotic and abiotic stresses. Recent studies suggest that exogenous melatonin applications can significantly enhance the post-harvest shelf life and quality of horticultural produce, making it a promising tool for extending storage and maintaining freshness.

This study evaluated the impact of melatonin at varying concentrations (50, 100, 200, and 500 $\mu\text{mol L}^{-1}$) on maintaining firmness and reducing peel browning in Indian jujube fruits stored for 8 days under ambient conditions ($22\pm 3.2^\circ\text{C}$ and $48\pm 11.7\%$ RH). The results revealed that melatonin treatments at 200 and 500 $\mu\text{mol L}^{-1}$ were particularly effective in suppressing physiological weight loss (PLW), retaining firmness, and delaying peel browning compared to lower concentrations (50 and 100 $\mu\text{mol L}^{-1}$) and untreated control fruits. Melatonin application also preserved higher levels of ascorbic acid, phenols, and flavonoids, slowed changes in total soluble solids (TSS) and total soluble sugars, and enhanced the overall antioxidant capacity of the fruits during storage. Furthermore, it inhibited the activity of enzymes such as polyphenol oxidase (PPO) and polygalacturonase (PG) while boosting the activity of antioxidant enzymes like catalase and superoxide dismutase (SOD). In contrast, lower melatonin concentrations (50 and 100 $\mu\text{mol L}^{-1}$) showed no significant effect compared to the control. These findings underscore that melatonin treatments at 200 and 500 $\mu\text{mol L}^{-1}$ are effective strategies for maintaining the postharvest quality and extending the shelf life of Indian jujube fruits.

EFFECT OF ROW RATIOS, ROW DIRECTION AND NITROGEN LEVELS IN INTERCROPPING OF PIGEON PEA (*CAJANUS CAJAN* L.) WITH BABY CORN (*ZEA MAYS* L.)

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Abstract

An investigation entitled “Effect of Row Ratios, Row Direction and Nitrogen levels in intercropping of pigeon pea (*Cajanus cajan* L.) with baby corn (*Zea mays* L.)” was designed and conducted during kharif season of 2022-23 and 2023-24 at Zonal Research Station, Darisai. The experiment was laid out in RBD with 21 treatments and replicated thrice with intercropping of pigeon pea with baby corn in 1:1 and 2:2 row ratio, sole crop of pigeon pea, pigeon pea in paired row and sole crop of baby corn was also taken. There were three levels of nitrogen, three sole crops and three row directions. The variety used were UPAS-120 and Golden baby for pigeon pea and baby corn respectively. The pooled data of two years revealed that when 100 % RDN to baby corn + 75 % RDN to pigeon pea + East-West row direction gave maximum plant height (156.37 cm), dry weight (49.11 g), number of cobs/plant (2.42), and baby corn yield (12.72 q/ha) respectively and some parameters viz, length of cob with husk (16.28 cm) length of cob without husk (8.48 cm), weight of cob with husk (25.81g), weight of cob without husk (8.49g) was recorded in treatment combination C1F3D2 - (Pigeon pea + baby corn (1:1) row ratio + 75 % RDN to pigeon pea + 100 % RDN to baby corn + East-West row direction) respectively. Similarly when pigeon pea was applied with 100 % RDN + 2:2 row ratio in paired row + East-West row direction recorded maximum plant height (164.42 cm), dry weight (157.33g), number of pods/plant (123.00) harvest index (30.03 %) and grain yield (18.03 q/ha) respectively. In some of the parameters viz number of nodules at 90 DAS (30.33), number of grains per pod (3.63) and stalk yield (45.13 q/ha) was



recorded in treatment combination C1F2D2- (pigeon pea + baby corn in (1:1) row ratio + 100 % RDN to pigeon pea + 75 % RDN to baby corn + East-West row direction) respectively. Land Equivalent Ratio was also worked out and it was found that in all treatment combination, LER was found to be more than 1. Thus, there was compensation between component crops and yield advantage in intercropping. Aggressivity was also worked out and Aab was found to be more than 0 (Zero). Thus, crop 'a' (pigeon pea) is more competitive than crop 'b' (baby corn). In this intercropping, pigeon pea is dominant crop and baby corn is dominated crop. In other words, pigeon pea is more aggressive than baby corn. Maximum benefit cost ratio (3.22, 3.11 and 3.17) was recorded in treatment combination T13 – (Pigeon pea + baby corn (2:2) + 100% RDN to both crops + East-West row direction).

GENETIC ADAPTABILITY AND KARYOTYPIC VARIATIONS IN APHID PEST

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Abstract

In regions like Himachal Pradesh and Kashmir, aphids (Hemipterans) are recognized as significant pests affecting fruit crops such as apples, pears, and apricots. These insects are among the most destructive phytophagous pests, feeding on the phloem sieve tube elements of the plants. However, their impact extends beyond direct damage as they also serve as vectors of plant viruses, contributing to an additional 20-80% reduction in crop yields. They are well known for the secretion of honeydew, a carbohydrate-rich substance that promotes the growth of sooty molds. Although these molds do not directly infest plants, they cause indirect damage by covering leaves and fruits with black mycelium, obstructing photosynthesis and further weakening the plants. From a cytogenetic perspective, aphids are fascinating due to their rapid karyotypic evolution. They possess holocentric chromosomes characterized by multiple functional centromeric regions. This polycentric structure is responsible for fusion and fragmentation, leading to karyotypic variations that contribute to aphids' evolutionary success and adaptability. In summary, the review focuses on aphids' life cycles, karyotypic variations, and chromosomal rearrangements, with particular attention to the use of banding techniques to study the comparative cytogenetics and to spot the structural chromosomal aberrations such as deletion and translocation. Understanding these genetic aspects is crucial for developing more effective pest management strategies in regions where aphids are major threats to fruit crops.

GLUTEN-FREE FLOURS: ESSENTIAL ALTERNATIVES FOR CELIAC DISEASE PREVENTION AND PROMOTING HEALTHIER LIFESTYLES GLOBALLY

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Abstract

Celiac disease, a chronic autoimmune disorder triggered by gluten ingestion, affects millions worldwide. Gluten, a protein found in wheat, barley, and rye, damages the small intestine lining in susceptible individuals, leading to malabsorption of nutrients, severe digestive discomfort, and long-term health complications. As there is no pharmaceutical cure, a strict gluten-free diet is the cornerstone for managing and preventing the onset of symptoms. Gluten free flours have emerged as essential substitutes for traditional grain flours, offering a promising solution for individuals with celiac disease or gluten sensitivity. Flours derived from millet, rice, quinoa, almond, coconut, and teff not only eliminate gluten but also provide diverse nutritional benefits. For instance, teff flour is rich in iron, calcium, and dietary fiber, while quinoa flour offers high-quality plant protein and essential amino acids. These alternatives not only cater to dietary restrictions but also promote better health by integrating superior nutrients into daily meals. The availability and innovation in gluten-free flours have revolutionized food production, making gluten free products palatable and accessible. Advances in blending techniques and fortification have addressed key challenges like texture, taste, and consistency, ensuring consumer acceptability. Furthermore, gluten-free flours contribute to sustainable agriculture by utilizing underutilized grains, thus supporting biodiversity and local farming economies. Raising awareness about the importance of gluten-free flours is crucial for public health. They not only



help in managing celiac disease but also prevent its misdiagnosis by fostering better dietary habits. As gluten-free diets gain popularity beyond medical necessity, these Bours are pivotal in creating inclusive food systems that prioritize health and sustainability. Collaborative efforts among food scientists, nutritionists, and policymakers are imperative to enhance research, affordability, and distribution of gluten-free flours globally.

ACTIVATION OF RESISTANCE IN MUNGBEAN THROUGH SAR INDUCERS AGAINST WEB BLIGHT DISEASE

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Abstract

SAR inducers significantly reduced the intensity of web blight over control during both the years as well as under pooled basis. The effect of SAR activators was studied against the web blight of mungbean under artificially inoculated field conditions. Results of pooled analysis revealed that minimum disease intensity (31.70%) was recorded in Salicylic acid with 43.18% decreased intensity. It was significantly superior over all treatments. This was followed by aminobutyric acid (35.27%), isonicotinic acid (39.52 %) and oxalic acid (43.26%). Tricantanol was found least effective as it gave (44.32%) higher intensity. Salicylic acid, aminobutyric acid and isonicotinic acid were observed statistically at par with each other. The pooled data of seed yield revealed that maximum seed yield (7.51 q/ha) was recorded in salicylic acid with increased seed yield (44.20%) over control followed by aminobutyric acid (7.12 q/ha), isonicotinic acid (6.65 q/ha) and oxalic acid (6.24 q/ha). Minimum seed yield (6.12 q/ha) was recorded in tricantanol. All pooled data of seed yield, and all SAR activators were found statistically significant over control.

CONSEQUENCES OF CLIMATE CHANGE ON BIODIVERSITY AND AGRICULTURAL PRODUCTION

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Abstract

Every phenomenon occurring in nature depend upon temperature. In current time we are strongly affected from environment change. We did a lot of work as invention and development for betterment of human being in twenty and twenty-first centuries. But we forget that boons run with curse. Now consequences of all activities of human society are generating global warming. Now the ecosystem, composition of atmosphere, soil, sea level, metabolic process in animals and plant kingdom, coordination among animals and plants, species, phenology, population, production, decomposition, life cycle, weather, natural disasters, rain, drought, water level etc. are all disturbed. Due to the change in these conditions, quality as well as yield of crop is gradually decreasing. Excessive emission of greenhouse gases (CO₂, methane and nitrous oxide) in recent decades largely due to using of coal and fuels and deforestation for industrialization and urbanization are the main cause of climate change. Due to drastic change in weather, reports and data show the loss in crop production as well as nutritional value of food grains. Ecological balance in nature depends upon biodiversity which is disturbed day by day.

FOOD SECURITY IN THE FACE OF CLIMATE CHANGE

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Abstract

Food security refers to the availability of food and one's access to it. A household is considered food-secure when its occupants do not live in hunger or fear of starvation. According to the World Resources Institute, global per capita food production has been increasing substantially for the past several decades. In developing countries, often 70% or more of the population lives in rural areas. In that context, agricultural development among smallholder farmers and landless people



provides a livelihood for people allowing them the opportunity to stay in their communities. In many areas of the world, land ownership is not available, thus, people who want or need to farm to make a living have little incentive to improve the land. Climate change may affect food systems in several ways ranging from direct effects on crop production (e.g. changes in rainfall leading to drought or flooding, or warmer or cooler temperatures leading to changes in the length of growing season), to changes in markets, food prices and supply chain infrastructure. The relative importance of climate change for food security differs between regions. For example, in southern Africa, climate is among the most frequently cited drivers of food insecurity because it acts both as an underlying, ongoing issue and as a short-lived shock. The low ability to cope with shocks and to mitigate long-term stresses means that coping strategies that might be available in other regions are unavailable or inappropriate. In other regions, though, such as parts of the Indo-Gangetic Plain of India, other drivers, such as labour issues and the availability and quality of ground water for irrigation, rank higher than the direct effects of climate change as factors influencing food security.

IMPACT OF LINE DEMONSTRATIONS OF IMPROVED NIGER VARIETY UNDER TRIBAL SUB PLAN IN SOUTH GUJARAT

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Abstract

Niger Research Station, NAU, Vanarasi, Gujarat had conducted the present investigation for five years during 2015-16 to 2019-20 in the tribal districts viz., Valsad and the Dangs of Gujarat state to know the yield gaps between scientific package and farmers practices along with popularization of improved niger variety under rainfed condition. Demonstrations on niger variety GNNIG-3 were conducted on farmer's fields (23.4 ha) during *kharif* season for five sequential years i.e. 2015-16 to 2019-20 under DAPSTC scheme (Formerly TSP), AICRP Niger, GoI to demonstrate the impact of improved agro-techniques on production and economic benefits under rainfed situations alongwith active involvement of tribal farmers in various oilseed trainings and visits. The average seed yield of niger demonstration was 409 kg/ha as compared to farmers practices 262 kg/ha with an yield increment of 65.54 % over farmers practices for the five years. The result indicated that the niger demonstrations has given a good impact over the farmers practice in tribal farming community. The average highest seed yield of 422 kg/ha has been recorded during 2019-20 year. The average extension gap 147 kg/ha has been found during period of investigation while the average highest extension gap 177 kg/ha was recorded during the initial phase of demonstration. Both, the technology gap and index were also found in lower range indicating feasibility of improved niger demonstration in tribal belt of region. Adoption of improved package of practices in Niger cultivation also recorded average higher B:C ratio as compared to Farmers Practice.

FINGER MILLETS WITH PULSES IN MID HILLS OF MEGHALAYA

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COGS-AS, CAU(I), Umium, Meghalaya

Abstract

A field experiment was conducted in CPGS-AS,CAU(I),Umium, Meghalaya with finger millet and pulses of greengram and blackgram. Ragi or finger millet (*Eleusine coracana*(L) Gaertn) is an important millet crop grown in India. It is a staple food crop in many hilly regions of the country. Millet are practiced by farmer in jhum fields of Meghalaya in mix cropping system. As millet are considered as climate smart crop and fits well in cropping system. Intercropping of finger millets and pulses are an important combination to enhance the yield of millet with nitrogen fixation by legumes. In different row ratios of replacement and additive series, greengram and blackgram were intercropped with finger millet in 1:1,2:1,2:2,3:3,4:2 and 2:2(paired) row ratios. The Leaf Area Index, Dry Matter production and Crop Growth Rate are important phenomenon leading to yield of the crop. Dry matter production directly reflects the overall plant biomass and potential grain yield, serving as a crucial indicator of the crop's growth and ability to accumulate nutrients, which ultimately determines the final harvest quantity of finger millet grains. Among the intercropping systems the Leaf Area Index, Dry Matter production and Crop Growth Rate of finger millet were found highest in the row ratio of 2:1 and 4:2 with greengram at 30, 60, 90 days after sowing and at harvest.



BIOFERTILIZERS AS AN EFFECTIVE MANAGEMENT STRATEGY IN ONION CROP TO IMPROVE PHYSIO-BIOCHEMICAL AND TOLERANCE TO WATER DEFICIT STRESS IN SEMI-ARID ENVIRONMENTS

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Abstract

Biofertilizers are organic products comprising of specific microbial culture or their consortia. It not only reduces the load of chemical fertilizers but also involved in protecting crop from several biotic and abiotic stresses. Onion is an economically valuable vegetable crop with numerous medicinal and economic values. Its shallow root system limits its capacity to extract water from deeper soil zones that make the crop prone to water stress limiting its growth under limited irrigation supply. This work aim to identify promising biofertilizers that can sustain onion crop growth and yield under limited water supply. An experiment was conducted to demonstrate the effect of different biofertilizers on onion crop growth, photosynthesis apparatus, bulb yield and quality under water deficit stress. Experiment consisted of five biofertilizers (*Azotobacter* spp., *Azospirillum* spp., Potassium Solubilizing bacterial consortia, Phosphorus Solubilizing bacteria spp., *Piriformospora indica*) and two control treatments (Control with fertilizer dose 110:40:60:30 kg NPKS and 15 tons FYM per hectare and absolute control without fertilizer and microbial inoculation). Two water levels are maintained to subject the crop under water deficit stress at bulb development stage (well watered and water deficit stress). Findings from the present study highlights that most of the promising phenotypic traits improved in response to biofertilizers compared to control under water deficit stress. Water deficit stress significantly affects the photosynthesis apparatus however; biofertilizers treatment helps the crop to maintain their photosynthesis and stomatal conductance under limited water supply. Several biochemical parameters representing the crop survival and bulb quality was maintained with biofertilizers under stress. Among the employed culture, seedling inoculated with *Azotobacter* spp. performs superiorly with respect to yield and crop growth under water deficit stress. Taken altogether, work thus highlight the role played by biofertilizers in maintaining onion crop growth and production under limited water supply in arid and semi regions.

TRANSFORMING *BRASSICA JUNCEA* L.: UNLOCKING EMS-INDUCED ALS HERBICIDE RESISTANCE FOR EFFECTIVE CONTROL OF *OROBANCHE AEGYPTIACA*

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Abstract

Indian mustard (*Brassica juncea*), a key oilseed crop, is critical for meeting India's edible oil demand. However, insufficient production necessitates substantial imports. *Orobanche aegyptiaca*, a parasitic weed, severely threatens mustard yield, particularly in major growing regions. Developing Orobanche-resistant mustard varieties remains a challenge due to the limited availability of resistant donors in *B. juncea* germplasm. Herbicide-mediated resistance offers a promising solution. In this study, EMS mutagenesis was applied to the high-yielding mustard variety DRMRIJ-31, generating a mutant population. Screening for ALS-herbicide (metsulfuron) resistance began in the M₂ generation, with resistant plants advanced to M₃, M₄, and M₅ generations through self-pollination. Consistent herbicide resistance was observed across generations, with three mutant lines (DRMR-HR-2-1, DRMR-HR-52-2-2, DRMR-HR-75-1) demonstrating robust resistance at multiple locations in the 2023–24 Rabi season. Preliminary studies revealed reduced Orobanche infestation in herbicide-treated plants. Molecular analysis identified point mutations in the ALS gene associated with herbicide resistance. Physiological studies highlighted lower reactive oxygen species (ROS) accumulation and enhanced antioxidant activity in resistant plants compared to susceptible ones. These novel herbicide-resistant lines have significant potential as donors for developing high-yielding, Orobanche-resistant mustard varieties, contributing to self-reliance in edible oil production and strengthening India's agricultural sustainability.



TECHNOLOGY ASSESSMENT AND TRANSFER THROUGH CONVERGENCE WITH PUBLIC PRIVATE PARTNERSHIP

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Abstract

Initiatives for technology assessment and transfer for sustainable agricultural production systems and rural development is a comprehensive and model approach to examine the potential impact of technology application on certain sustainability issues. Innovative initiatives by IARI have contributed immensely to the development of roadmaps for national extension systems. Some of the integrated models of transfer of technology devised by the institute in the past have been effective not only in reaching the farmers but also in generating socio-psychological knowledge base to better understand the technology utilization and collectivization of behaviour of farmers. In the agriculture system, there are basket of technologies available which address farmer's income, nutritional security, climate change and sustainable agriculture. These technologies have to be on farmers' field at different location for their assessment and refinement under National Agricultural Research and Education System. The innovative partnership based frontline extension education research with inherently inter-disciplinary essence and having technological and socio-economic relevance to reach the distant farmers. Through this convergence approach, 03 ICAR institutes and 10 State Agricultural Universities and 24 reputed Voluntary Organizations spread across 15 States were brought under common responsibility with inter-disciplinary team of scientists at ICAR-IARI, as its nucleus to assess and demonstrate multiple technologies and practices. The quantifiable feedback which is a consequence of performance is helpful to the research system to work on the various issues raised by the farmer. After assessment, the appropriate refinement and modifications could be done by the researcher which in turn will lead to higher adoption and faster diffusion of the technologies. Thus the effective feedback mechanism enhances the functional linkage between the clientele, technologies and the development agencies. The model, which was operated in different parts of the country, proved that small and marginal farmers including farm women are highly motivated to adopt the modern technologies provided critical inputs and markets are made available. The system was found to be effective in providing all inputs and services in one convenient location. The farmer-to-farmer seed production and distribution programme helped in rapid multiplication of quality seeds by farmers themselves to ensure timely supply of seeds to a large number of farmers at remunerative prices.

EFFECT OF HEAVY METAL CONTAMINATED IRRIGATION WATER ON GROWTH, FLOWERING AND YIELD OF MARIGOLD CV. PUSA BAHAR

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Abstract

The rapid pace of urbanization and industrial growth has led to large amounts of industrial effluents mixing with sewage and river water. Due to the scarcity of irrigation water, marginal farmers are increasingly using such contaminated sewage water to irrigate their fields. Originating from Central and South America, particularly Mexico, marigold (*Tagetes erecta*) is one of the easiest annual flowers to grow due to its broad adaptability. It is extensively grown across India occupying the largest area among flower crops. The rapid growth and extensive root system of marigold along with its ability to establish itself in poor soils indicate that it may be suitable for the remediation of areas contaminated by metal pollution. Therefore, the present study was undertaken to assess the effect of heavy metal contaminated irrigation water on the growth, flowering and yield of marigold cultivar Pusa Bahar. One month old seedlings of marigold cultivar Pusa Bahar were transplanted in pots and irrigated with water containing varying levels of heavy metals (Ni and Zn) and there combination thereof. The results revealed that irrigation water involving Zinc @ 2 mg/L significantly improved plant height, spread, number of primary and secondary branches, number of leaves, leaf area, leaf fresh and dry weight and number of flowers in marigold plants. Zinc @ 2 mg/L also resulted in the highest shoot and root growth and biomass, highlighting its effectiveness in promoting shoot and root development. The Zn @ 2 mg/L treatment promoted seed development, seed yield, and seedling vigor. In contrast combined treatment of higher concentrations of Nickel and Zinc (Ni @ 2 mg/L + Zn @ 10 mg/L) negatively affected these growth, flowering and yield parameters. The results indicate that optimal concentrations of Zinc can promote growth, while excessive levels, especially when combined with Nickel, can inhibit it.



RSC IRRIGATIONS AND ITS NEUTRALIZATION INFLUENCE AGGREGATION IN VEGETABLES CULTIVATED SOIL OF NORTHWEST INDIA

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Abstract

Soil aggregation is a factor of stabilizing agents and cultural practices viz., tillage operation, organic application, mulching, quality of irrigation, crop rotations. Here, soil aggregation and its indices were evaluated in soils irrigated with RSC water and neutralization of alkalinity of irrigation with different reclamation agents after two years of field lysimeter experiment under vegetables crops [okra (*Abelmoschus esculentus* –tomato (*Lycopersicon esculentum*)] system. The experiment comprised a total of nine treatment combinations and laid out in factorial randomized block design (RBD) with three replications in which the RSC neutralization through mineral acid neutralizer (AN), liquid S (LS) and S^o–reaction product (CSR_P) along with the recommended dose of fertilizers were applied. A full dose of K fertilizer was applied to all the treatments. The N and P fertilizers were scheduled in the forms of urea and DAP for normal irrigation plots. Based on the crop coefficient and evapotranspiration demand of the crop, the RSC neutralizers were applied in lysimeters to reclaim RSC 3 and 6, and these amended and unamended waters were used through drip irrigation. Wet–sieving techniques were used to fractionate the soils into large macroaggregates (> 2?mm, LM), small macroaggregates (0.25–2.0?mm, SM), microaggregates (0.053–0.25?mm, MI), and silt–plus–clay particles (< 0.053?mm, CS). Results revealed that the proportion of water–stable macroaggregate fractions (> 0.25?mm, LA?+?SA) ranged from 11.19 to 33.5%. The mean weight diameter (MWD) and geometric mean diameter (GWD) was found between 1.18 to 1.54 and 0.91 to 1.15, respectively and the higher values obtained, when liquid sulphur (LS) was used to neutralized RSC 6 ($p<0.05$). Whereas, aggregate stability (AS) and aggregate rate (AR) ranged between 47.01 to 139.08 and 0.09 to 0.31, respectively and was found higher in elemental sulphur (CSR_P) used to neutralized irrigation water alongwith RSC 3 ($p<0.05$). Therefore, it can be concluded that neutralization of RSC water improved soil aggregation compared to RSC water.

SEASONAL BASED MONTHLY EXPORT PRICE FORECASTING OF FISH (SALMON) USING ARIMA MODEL

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Abstract

India ranks among the world's leading producers of aquacultured seafood. According to research, India has plenty of room to expand its fish and fisheries production if it makes full use of its vast aquaculture acreage. Fish and fish products are among the most commonly traded foods in the world today. According to the FAO, more than 60 million tons (live weight equivalent) of fish and fish products are exported each year. Over the last 40 years, developing nations' export growth has far outperformed that of developed nations. Salmon is a popular cuisine that is classed as an oily fish. It is considered nutritious due to its high protein, omega-3 fatty acid, and vitamin D content.

In this study, monthly export prices of fish (Salmon) from India were obtained from the indexmundi website between July 2013 and September 2024, and the ARIMA model was used to fit the data and anticipate future export prices. For forecasting, the Box-Jenkins (1970) ARIMA approach was used. The most popular and widely used forecasting model for time series data is ARIMA. The data was analyzed using the autocorrelation and partial autocorrelation functions. The model parameters were estimated using R programming software. The fitted model's performance was evaluated using several goodness-of-fit criteria, including AIC, BIC, and MAPE. According to empirical findings, the SARIMA (2,1,1)(1,0,0)[12] model was best suited for forecasting monthly fish (salmon) export prices to India. Projections are calculated from October 2024 to March 2025 based on the selected model. The fitted model indicates that the monthly export prices of salmon are rising. The monthly fish (salmon) export price figures are displayed both graphically and mathematically. Forecasting is an important part of the



process of advising policymakers. To tighten laws and create unforeseen consequences, decision-makers would ideally base their choices on precise projections. In addition, marketing strategists use the most precise forecasting models for developing, planning, and implementing marketing plans. These projections are especially valuable in altering marketing and policy initiatives to account for future changes.

BIOFERTILIZER POTENTIAL OF *AZOSPIRILLUM BRASILENSE*: PROMOTING RICE GROWTH AND BIOCONTROL EFFICACY

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Abstract

In this study, the rhizobacterial culture *Azospirillum brasilense* (NAIMCC-B-00896) was procured and evaluated for its plant growth-promoting traits. The analysis indicated that *A. brasilense* effectively performs dinitrogen fixation revealed by colonies growing on Jensen's medium prepared with deionized water and nutrient acquisition through the solubilization of phosphate (1.89 SI), zinc (1.91 SI) and potassium (1.37 SI), as well as in iron acquisition (1.70 SI) on Nutrient agar medium supplemented with CAS dye. Additionally, it demonstrated the production of key phytohormones, including indole acetic acid (IAA) production (49.33 µg/ml) independent and (72.00 µg/ml) dependent and gibberellic acid (GA) production (52.08 µg/ml), which are essential for plant development. The strain also exhibited other beneficial traits, producing hydrogen cyanide (HCN), ammonia and extracellular polysaccharides (45.83 µg/ml), which contribute to plant defense and stress resilience. Antagonistic activity tests confirmed its biocontrol potential, with positive results in dual culture assays and antibiotic resistance tests, indicating its capability to effectively suppress pathogens and resist antibiotics produced by them. Subsequent laboratory evaluations with rice seed (PR 126) demonstrated the culture's efficacy in promoting growth and enhancing seed germination rates under axenic conditions. A mini-pot experiment with sand further confirmed that *A. brasilense* can improve early-stage plant development and increase rice seed germination. These results demonstrate the diverse functions of *A. brasilense* in supporting plant growth, optimizing nutrient availability, and offering biocontrol, underscoring its promise as a biofertilizer for boosting crop productivity.

HOW LIVESTOCK DUNG CAN BE UTILIZED EFFECTIVELY AT THE FARM HOUSEHOLD LEVEL: CASE STUDY OF FARMERS AND SUSTAINABLE MANAGEMENT PRACTICES

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Abstract

At village, livestock rearing goes hand in hand along with crop cultivation. Like food, shelter, clothing, energy is the basic requirement of human life. Human depend a lot on fossil fuels. The dependence on fossil fuels creates a lot of environmental hazards and in turn affect human lives. There is always a huge cry on depletion on fossil fuels. Hence, there is a need for exploring alternative source of energy. The energy resource in rural areas need to be tapped and utilized effectively. The livelihood improvement of individual farm over a period of time contribute to national development. For this, awareness need to be created among the farm household members about the various advantages of the resources present in the farm. One among the resources which farmers can be utilized is the livestock dung available in the farm. The objective of the paper is to create among the various stakeholders who are working at the grassroot level to understand the status, advantages of livestock dung utilisation and their merits so as to increase the standard of living and quality of life of the farmers who are dependent on the farm for livelihood. This paper covers livestock status and energy use at the village, livestock dung utilization in the farm, current status of fuel production in the village and its hazards, alternative to firewood, need for biogas implementation in the farm, status of schemes or programs for the farmer, utilization of chemical fertilizers and soil, biogas slurry utilization in the farm, biogas slurry and nutrient enhancement of the soil. The adoption of manure management at farm level is a sustainable management practices and environment friendly technology at micro level which helps not only manage pollution, waste management but also an asset for future generation.



EFFICACY OF BIO-RATIONALS AGAINST PINK POD BORER, *CYDIA PTYCHORA* IN SOYBEAN

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Abstract

The field experiment was carried out at All India Co-ordinated Research Project on Soybean, Main Agricultural Research Station, University of Agricultural Sciences, Dharwad to know the efficacy of different bio-rationals against pink pod borer *Cydia ptychora* in soybean during *kharif* 2022. The experiment consisted of eight bio-rational treatments including untreated control in a plot size of 5 m X 4 m in Randomized Block Design with three replications. The soybean variety JS 335 was sown at a spacing of 30 cm x 10 cm in the month of July. The first spray was given at the flowering stage (50 DAS) and subsequent sprays were given at 10 days intervals till harvesting. The efficacy of bio-rationals in managing the pod borer was judged on the basis of larval count per plant, the percentage of damaged pods and seeds at the pod maturity stage. The results revealed that among different bio-rationals, lowest mean larval population was recorded in nimbecidine 3000 PPM (2.67 larvae/plant) followed by was Garlic chilli kerosene extract 5% (2.78 larvae/plant) which are found statistically on par with each other and superior over other treatments. This is followed by *Btk* (3.69 larvae/plant) and *Metarhizium rileyi* (3.93 larvae/plant) which are statistically on par with each other. The lowest per cent pod damage over control was recorded in the treatment nimbecidine 3000 PPM (66.44%) followed by GCKE 5% (59.22%), *Btk* (48.59%), *M. rileyi* (45.65%) and Brahmastra (44.39%). The lowest per cent seed damage was noticed in nimbecidine 3000 PPM and GCKE 5% with least mean per cent seed damage of 12.96 and 13.48 per cent respectively. The highest seed yield was obtained from nimbecidine 3000 ppm (19.34 q/ha) followed by Garlic chilli kerosene extract @ 5% (18.24 q/ha).

ENHANCING INDIAN MUSTARD (*BRASSICA JUNCEA* L.) PRODUCTIVITY THROUGH RHIZOBACTERIA-MEDIATED MOISTURE STRESS TOLERANCE

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Abstract

The increasing frequency and intensity of drought events, attributable to climate change, are significantly reducing agricultural productivity. Indian mustard (*Brassica juncea* L.) is an important edible oil crop mainly grown in marginal lands under rainfed ecosystems frequently suffered due to moisture stress resulted in seed yield penalty. Inoculation with rhizobacteria has been found to be an economical and eco-friendly solution for improving the drought tolerance ability of crop plants. Accordingly, the present study was undertaken at ICAR- Indian Institute of Rapeseed-Mustard Research, Bharatpur, Bharatpur during 2022-23 with the objective to enhance the drought tolerance in Indian mustard through seed inoculation with different microbes. Three soil microbial formulations (*Bacillus* sp. strain MRD 17 w5, *Bacillus casamancensis* strain MKS 6 (w5), and a consortia of *B. sp.* strain MRD 17 + *B. casamancensis* strain MKS 6 (w5), were compared with no inoculation along with three moisture regimes *i.e.*, severe moisture stress (no-irrigation), moderate moisture stress (50% deficit irrigation) and no moisture stress (2-irrigations) under split plot design with three replications. Most of the growth and yield parameters *viz.* plant height, dry matter accumulation/plant, number of primary and secondary branches/plant, number of siliquae/plant, seeds/siliqua and 1000-seed weight were reduced considerably under the moderate and severe moisture stress conditions as compared to no moisture stress. Seed inoculation with consortia of microbes significantly improved these aforesaid growth and yield parameters over no inoculation. The seed yield was significantly decreased by 37.0 and 15.3 % under severe and moderate moisture stress conditions over no moisture stress, respectively. Seed inoculation with microbial consortia was found to increase the mustard seed yield by 11.8 and 24.0 % over the strain MRD 17 w5 and control plots, respectively under moderate moisture stress condition, and it also resulted the at par yield as recorded under no moisture stress condition with control treatment. Thus, seed inoculation with rhizobacterial consortia could be beneficial in mitigating the impact of moisture



stress and enhancing the productivity of Indian mustard in the rainfed conditions, beside saving of precious water equal to at least one flood irrigation.

CONTRIBUTION OF PRODUCTION FACTORS TO THE YIELD AND ECONOMICS OF PEARL MILLET [*Pennisetum glaucum* (L.) R. Br.] IN WESTERN PART OF RAJASTHAN, INDIA

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Abstract

India is the largest producer of millets in the world. Rajasthan contributes 31.3 per cent of the total millet production in India. Pearl millet holds significant agricultural importance in India, particularly within arid and semi-arid regions of Rajasthan. In India, Rajasthan state leads global Pearl millet production with 5.15 Mt in 2022-23 and cultivated across 4.51 Mha. Generally, the farmers of Western drier part of Rajasthan are extremely facing the drought situation during the crop season and have very scarce resources of irrigation water for the crops. Therefore, wholly depends on the monsoon rains during kharif season. Hence, the production factors of pearl millet are mainly responsible for its good yields and profitability. The present experiment was conducted at ICAR-AICRP on Pearl Millet for the quantification of individual production factors of management towards productivity and economics in the pearl millet crop. This experiment was planned at two locations of Zone A1 (Mandor and Bikaner) and conducted during rainy seasons of kharif 2021, 2022 and 2023. The experiment comprises of 8 treatments were evaluated in RBD keeping three replications i.e. T₁: Full package & practices of the location [(RDF+ ZnSO₄ @ 25 kg/ha+ FeSO₄ @ 0.5-0.75% at 20-25 DAS + bioinoculant seed treatment (Azoteeka/as per availability) + thinning & gap filling + weeding & hoeing (3 & 5 Weeks after sowing)+ Irrigation], T₂: T₁- RDF, T₃: T₁- ZnSO₄ @ 25 kg/ha, T₄: T₁- FeSO₄ @ 0.5-0.75% at 20-25 DAS, T₅: T₁- bioinoculant seed treatment (Azoteeka), T₆: T₁- thinning & gap filling, T₇: T₁- weeding & hoeing (3 & 5 Weeks after sowing) and T₈: T₁- Irrigation. The study of data on Zonal Mean (Zone A1) basis showed that the maximum grain yield (25.77 q/ha) was recorded with the application of full package and practices. The maximum reduction of 64.1% was observed when irrigation was not applied and it was followed by without weeding (38.0%), without RDF (35.7%) and without thinning and gap filling (35.0%). The grain yield reduction among other treatments was between 12.8-19.3%. Similar trend was observed for stover yield (16.3-53.2%), gross returns (13.8-60.4%) and net returns (19.5-102.1%) across the treatments.

GENETIC ARCHITECTURE FOR SEED YIELD AND COMPONENTS TRAITS IN SUMMER SESAME (*Sesamum indicum* L.) POOLED ENVIRONMENTS

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Abstract

A study was undertaken to evaluate the magnitude of combining ability variance and effects of four females as testers and ten males as lines and their forty crosses in sesame for seed yield and component traits over environments. The F₁s along with parents were evaluated in RBD with three replications at the Agricultural Research Station, J.A.U., Amreli and Department of Seed Science and Technology, College of Agriculture, Sagadivdi Farm, J.A.U., Junagadh, Gujarat. The analysis of variance for combining ability revealed that the variances due to lines, testers and lines x testers were significant for all the characters over environments (except variance due to lines for days to flowering, 1000-seed weigh and seed yield per plant which indicated the importance of both additive and non-additive types of gene action. Parents AT-285, G.Til-1, RT-54, AT-265, AT-306, AT-341 and G.Til-10 offered the best possibilities for exploitation in the development of improved lines with enhanced yielding ability. It is suggested that population involving these parents in a multiple crossing programme may be developed for isolating desirable



recombinants. The hybrids Khadkala-S x G.Til-1, AT-307 x AT-285, AT-322 x AT-285, AT-319 x G.Til-10 and AT-341 x G.Til-10 were high yielding and heterotic along with desirable sca effect for seed yield per plant over environments. These could profitably be exploited through heterosis breeding for general cultivation in order to increase the yield potentiality in sesame.

SEASONAL INCIDENCE TREND OF RICE INSECT PESTS IN CHHATTISGARH AGRO-ECOSYSTEM

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Abstract

Rice is economically, socially and culturally important to a large number of people across the globe. The rice crop is subjected to damage by many numbers of insect pests. Abiotic factors regulate seasonal incidence, population count and development rates of the pest and natural enemies. Among the abiotic parameters; temperature and relative humidity play key role that regulates population dynamics, developmental rates and seasonal incidence of the insects and their natural enemies. Such information is essential in developing pest management programmes with economical and ecological balance. Keeping in the mind of above fact, the research work was conducted in six blocks of Balaghat i.e. Waraseoni, Lalbarra, Balaghat, Khairlanji, Lanji, Kirnapur. The data was recorded at fortnightly from nursery to harvesting of the crop. The seasonal activity of the major insect pests in rice were recorded on the basis of infestation percent in case of stem borer (% dead heart & white ear head), leaf folder (% damaged leaf) and gall midge (% silver shoot) and the nymph and adult population per hill basis in case of hoppers and gundhi bug. The larval populations of green horn caterpillar and army worm were recorded on hill basis. On the basis of overall mean, the maximum pest activities were recorded at late tillering and panicle initiation stage of crop during 2nd fortnight of September and 1st fortnight of October. The maximum percent infestation of stem borer (11.66%) and leaf folder (7.65%) were recorded during 1st fortnight of October. The gall midge infestation was started from transplanting of crop and continues up to late tillering stage with highest peak (9.38% silver shoot) during 1st fortnight of September. In case of sucking pest GLH and BPH, the maximum nymph and adult populations of green leaf hopper (1.48/hill) and brown plant hopper (33.42/hill) were also recorded during 1st fortnight of October. The highest populations of gundhi bug (1.82) and army worm (1.76) were recorded 2nd fortnight of October at milking stage. The maximum grasshopper (1.48/hill) and green horn caterpillar (1.42/hill) were noticed during 1st fortnight of October. The maximum seasonal incidence of stem borer, leaf folder, BPH, GLH, gundhi bug, army worm and green horn caterpillar were recorded at Lanji and gall midge and grasshopper were noticed at Kirnapur and Khairlanji blocks.

EVALUATION OF *TRICHODERMA VIRIDE* AND *PSEUDOMONAS FLUORESCENS* TO TEST THE COMPATIBILITY WITH DIFFERENT FUNGICIDES

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Abstract

Integrated disease management (IDM) of plant diseases is gaining more attention in present due to residue effect by excessive use of pesticides for crop. The use of environmental eco-friendly microorganisms has proved to be useful in plant disease management with the limited use of chemicals. Among various fungal and bacterial biocontrol agents *Trichoderma* spp and *Pseudomonas* spp are extensively used in management of fungal diseases with the integration of fungicides, but most of the chemicals have toxic effect on microorganisms. So, before use of antagonist with the integration of fungicides it's essential to test compatibility among them in the laboratory. The present study was conducted to test the compatibility of seven fungicides viz; Carbendazim, Azoxystrobin, Propiconazole, Tebuconazole, Hexaconazole, Chlorothalanyl and Copper-oxochloride at 50, 100, 250, 500 and 1000 ppm with *T. viride* -T₅ (T.v₀₁) and *P. fluorescens* (P.f₀₁) by poisoned food technique amended in potato dextrose agar medium. Among these fungicides, Azoxystrobin was found most compatible with *T. viride* and *P. fluorescens* with least per cent growth inhibition (0.78, 2.35, 3.92, 11.76 and 19.61 of *T. viride* and 0.00, 0.00, 0.00, 0.00 and 1.67% of *P.*



fluorescens) per cent at 50, 100, 250, 500 and 1000ppm respectively. Copper-oxychloride was found compatible with *T. viride* up to 250 ppm. While, in case of *P. fluorescens* it was incompatible with the maximum growth inhibition (5, 9.17, 11.25, 14.17 and 22.0%) per cent at 50, 100, 250, 500 and 1000ppm.

ENHANCING WATER PRODUCTIVITY OF WHEAT THROUGH IMPROVED WATER MANAGEMENT PRACTICES AT FARMER'S FIELD IN SOUTH-EASTERN RAJASTHAN

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Abstract

Wheat (*Triticum aestivum* L.) is one of the most important staple food crop of India and occupies a notable position among the food grain crops. Its productivity is low in Chambal command area of Rajasthan due to lack of adoption of water management practices. Keeping in view, 18 field demonstrations were conducted at LMC&RMC of Chambal command area during 2018-19 to 2020-21 under operational research programme of AICRP on irrigation water management at Kota with the objective of enhancing crop and water productivity at field level and to show benefits of irrigation water management technology to them in real farm situation. Improved water management practices include four irrigations at CRI, tillering, flowering and milking stages with 6 cm depth of water by border strip method (6 m x 50 m) at 80 per cent cut off ratio and it was compared with flood method of irrigation with no control over the depth and usually applied 10 cm. For assessing impact of improved water management technology (IT), the adjoining field with similar area cultivated to wheat crop by the farmer himself was considered as control plot (Farmers practice). Mean data of three year revealed that wheat yield (5345 kg/ha) increased by 8.79 % as compared to farmers practices. Water use efficiency (148.5 kg/ha-cm) also higher in improved water management practices over farmers practice (98.27 kg/ha-cm).

PERFORMANCE OF ROOT SUCKER PROPAGATION TECHNIQUE OF SEWAN GRASS IN HOT ARID REGION DISTRICT BARMER, RAJASTHAN

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Abstract

Perennial grasses play an important role in bridging gap between demand and supply of fodder. In the hot arid zone the fodder is always short in supply and a deficit of around 61% green and 17% dry fodder is evidenced even in normal rain fall years. Different agro techniques and propagation technique were standardized for raising pastures and high yielding range of grasses were identified. The most of the grasses were propagated by seed or root suckers. In pasture land of Barmer root suckers techniques were introduced in first time, the survival was found good in the region. The livestock population in arid district occurs 30.18 million out of the total population 57.73 million in Rajasthan play an important role in the major states of India. The grasses have many tangible and nontangible benefits in the economy of arid zone. These grasses provided nutritive feed to the livestock at low cost and improve the soil health and soil conservation. It increases the pressure of grazing land that lead to deterioration of existing rangelands. Thus, these arid rangelands are in poor condition due to overgrazing and negligence of the community.

A field experiment was undertaken at pastureland of Chitrakapur village in Barmer district of Rajasthan having typical desert soils, poor in fertility, low water holding capacity and organic matter content. The study was taken for the performance of root suckers of the seven grasses in arid region of Barmer. The perennial grass named as sewan (*Lasiurus indicus*) was planted through root suckers at a spacing of 30 x 10 cm during 2022-23 & 2023-24, survival was found up to 90%. At present in all 5 ha area grass seed has been expanded and covered the species including the desert forestry trees in the pasture land having excellent growth in the community land. During this year total 70.2 mt/ha green fodder & 35 mt/ha dry fodder have been received from sewan grass by root suckers propagation while 45.8 mt/ha green fodder & 25 mt/ha dry fodder have been received from dhama grass through seed sowing in the community pasture land.



EVALUATING SOIL FERTILITY USING REMOTE SENSING AND GIS: A TOOL FOR ENHANCED AGRICULTURAL PRODUCTIVITY

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Abstract

Soil fertility assessment is essential for sustainable agricultural productivity, allowing for targeted nutrient management and reducing the environmental impacts of over-fertilization. Traditional methods are often labor-intensive, spatially limited, and less effective across large or varied landscapes. Remote Sensing (RS) and Geographic Information Systems (GIS) offer a scalable, innovative solution that utilizes satellite imagery and spatial analysis to precisely monitor and map soil fertility variations across extensive areas. This study investigates the application of RS-GIS technology for assessing soil nutrients and fertility across different agro-ecological zones. By combining multi-spectral satellite data with geospatial analysis, this approach generates detailed, real-time fertility maps that highlight variations in nitrogen, phosphorus, potassium, organic matter, and other key nutrients. Such maps enable site-specific fertilizer application, boosting nutrient use efficiency and promoting balanced fertilization. Moreover, RS-GIS provide a data-driven framework for identifying nutrient-deficient areas, facilitating the development of sustainable fertilization strategies. This approach not only enhances crop productivity but also minimizes nutrient leaching and runoff, key contributors to soil and water pollution. The findings underscore RS-GIS as a transformative tool for precision agriculture, with potential to conserve resources, lower production costs, and strengthen agricultural resilience.

FODDER QUALITY AND SOIL MICROBIAL STATUS AS INFLUENCED BY NANO UREA (NITROGEN) APPLICATION ON OATS (*AVENA SATIVA* L.)

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Abstract

The experiment was carried out during *rabi* season 2020 at the Agronomy research farm, ICAR-NDRI, Karnal in Randomized Block Design with 4 replications. The treatments comprised of T₁: Absolute control; T₂: 100% RDN through Urea; T₃: 75% RDN + 25% N through Nano-N; T₄: 50% RDN + 50% N through Nano-N; T₅: 25% RDN + 75% N through Nano-N and T₆: 100% RDN through Nano-N with four replications. Application of 100% RDN through Urea recorded the maximum dry matter contents 16.28 and 16.03%, crude protein content 10.78 and 10.48%, ether extract contents 2.66 and 2.46%, total digestible nutrients 60.65 and 59.88%, digestible dry matter 64.34 and 63.87%, dry matter intake 2.29 and 2.17%, at the first and second cut, respectively. The available N, P and K in soil microbial activities (bacteria, fungi and Actinomycetes) were significantly increased by using 100% RDN through urea. Application of 75% RDN + 25% N through Nano-N was found statistically at par with application of 100% RDN through urea.

CROP REGULATION IN GUAVA

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Abstract

Guava (*Psidium guajava* L.) is commonly known as the apple of the tropics and subtropics and is native to Central America and South America but is now widely grown in many tropical and subtropical regions of the world. It is known for its unique flavor, aroma, and nutritional value. The fruit has a distinctive fragrance and a sweet, juicy flavor that is often described as a combination of pear and strawberry. The fruit is of variable shape and size like round or oval-shaped. Peel of guava fruit is thin, ranging in color from green, purple, red and yellow. The flesh of the fruit can be white, pink, or red, and it contains



numerous small and hard seeds. Guava fruit is high in vitamin C (125-300 mg/100 g pulp), dietary fiber (5.14-6.04%), antioxidants, pectin content, and lycopene, making it a nutritious addition to a healthy diet. Normally, guava comes into bearing in three light crops with variable quantities and qualities of the various flowering flushes in a year. There are three distinct flowering seasons, i.e., February-March (Ambe Bahar), June-July (Mrig Bahar), and October-November (Hasth Bahar), with the corresponding harvesting times during the rainy, winter, and spring seasons, respectively. Therefore, to obtain higher fruit yield with high quality during a particular period, bearing guava trees are given a resting period with artificial means so that the natural flowering tendency of the trees is altered. This can be achieved through root exposure and its pruning, withholding irrigation water, deblossoming, chemicals/PGRs application, shoot bending, and two leaf pair shoot pruning.

EXPLORING PATHOGENIC VARIABILITY OF *XANTHOMONAS ORYZAE* PV. *ORYZAE* POPULATIONS IN SOUTH INDIAN

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Abstract

The rice bacterial leaf blight, caused by the pathogenic bacterium *Xanthomonas oryzae* pv. *oryzae* (Xoo), represents a significant agricultural threat that impacts rice cultivation across diverse climatic zones, particularly devastating rice production in Asian countries within both tropical and temperate regions. The disease severity of this bacteria differs from geographical regions, strain (race) and the host genotype. However, the disease severity differs from place to place and efforts have made to understand the pathogenicity of different isolates of *Xoo* from different locations of India. All the isolates were successfully cultured in the laboratory and were confirmed by 16S rRNA sequencing. The sequence homology among the strains was similar except Xoo7 and has 99- 100% homology with *Xoo* strain PXO99A. Based on nearest neighbour analysis first group of isolates are close to PXO61, OS198 and PXO 364 isolates from outside India. Second group with only Xoo7 is close to PXO513. Further the amounts of exopolysaccharide (EPS) produced were quantified that varied depending on *Xoo* isolates. The EPS were produced more by isolate Xoo5 followed by Xoo4, Xoo7 and Xoo10 and the least was in Xoo3. The pathogenicity assay among the *Xoo* isolate showed that all isolates were virulent and amongst them Xoo3 showed least necrotic lesions with less bacterial count (in planta). Furthermore, PCR analysis confirmed the presence of multiple effectors across all isolates. However, the two non-TAL effector genes, XopP and XopV, were not detected in any of the isolates. This study highlights the diversity of *Xanthomonas oryzae* pv. *oryzae* among the isolates collected from south India.

TO DEVELOP SUSTAINABLE MANAGEMENT SYSTEM FOR HIGHER PRODUCTIVITY AND PROFITABILITY OF ISABGOL THROUGH PRECISE USE OF WATER AND NUTRIENT IN WESTERN RAJASTHAN

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Abstract

A field experiment was conducted at farm of Dr B R Choudhary Agricultural Research Station, Mandor (Jodhpur) during the *rabi*, 2019-20 & 2020-21 to study the develop sustainable management system for higher productivity and profitability of isabgol through precise use of water and nutrient in Western Rajasthan. Sub-Surface drip irrigation at different available moisture deficit levels viz. Irrigation at 0 % available moisture deficit viz. Irrigation at 20 % available moisture deficit, Irrigation at 30 % available moisture deficit, Irrigation at 40 % available moisture deficit Irrigation at 50 % available moisture deficit and fertility levels viz. 25% recommended fertilizer dose, 50% recommended fertilizer dose, 75% recommended fertilizer dose and 100% recommended fertilizer dose were evaluated. The field experiments were laid out in a split plot design (SPD). The experiment was conducted on effect of sub-surface drip irrigation with fertigation on yield, water and nutrient use efficiency of isabgol. The pooled data of seed yield (946 kg/ha), water use efficiency (299 kg/ha-cm) and BC ratio (2.29) of isabgol were significantly higher with irrigation at 30% available moisture deficit (AMD) over 40%, 50% and 60% ADM. Maximum net returns (Rs 52397/ha) were recorded with irrigation at 20% ADM followed by 30% ADM. Seed yield (892



kg/ha), water use efficiency (302 kg/ha-cm) net returns (Rs 46006/ha) and B:C (2.14) ratio were reported significantly higher in with 75% RDF but it was statistically at par with 100 RDF.

LEAFHOPPERS INCIDENCE ON MANGO CULTIVARS IN CORRELATION TO WEATHER PARAMETERS IN NORTH EASTERN TRANSITIONAL TRACT OF KARNATAKA

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Abstract

Mango (*Mangifera indica* L.) is the national fruit of India and it is severely infested by mango leafhoppers causing 20-100 per cent damage to inflorescence. In the present experiment influence of weather parameters on incidence of leafhoppers on different cultivars of mango studied at College of Horticulture, Bidar during 2015-2017. The study shows that weather parameters like maximum and minimum temperature displayed significantly positive correlation with leafhoppers population having 'r' value ranging from (0.60 to 0.77), (0.50 to 0.67) and (0.52 to 0.70), (0.29 to 0.52), respectively during 2015-16 and 2016-17, excluding Alphonso, Neelum and Mallika cultivars. Similarly, the relative humidity (RH) maximum and minimum level displayed negative significant correlation among the cultivars of mango during 2015-16 and 2016-17. Thus this experimental result helps in predicting the leafhopper incidence in mango cultivars in North eastern Transitional zone of Karnataka.

EFFECT OF PLANTING GEOMETRY ON GROWTH AND YIELD OF BROAD BEAN VARIETIES

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Abstract

Legume crops has very important role in the food and soil systems. The broad bean is used as a vegetable, green or dried, fresh or canned. Broad bean seeds are used as human food in developing countries and as animal feed in industrialized countries. Faba bean is an important source of protein for humans and animals. It plays an important role in crop rotation and improvement of soil biological activities. The experiment was conducted during *Rabi* 2020-21 at the Vegetable Research Field, College of Horticulture, Mandsaur. Twelve treatment combinations comprising two varieties (V1 -Pusa Udit and V2 - Pusa Sumeet) and six plant spacing S1 (30x10 cm), S2 (45x10 cm), S3 (60x10 cm), S4 (30x15 cm), S5 (45x15 cm), and S6 (60x15 cm) were evaluated in factorial RBD with three replications. The variety Pusa Udit (V1) recorded maximum and significantly higher growth and yield attributes. Variety Pusa Udit recorded maximum seed yield per plant (16.52 g) with 42.16 per cent increase over variety Pusa Sumeet having 11.62 g per plant, similarly, maximum and significantly higher seed yield (17.66 q/ha) with 12.34 per cent increase over Pusa Sumeet (15.72 q/ha). The planting geometry S1 recorded maximum plant height and S6 recorded higher growth and yield attributes (31.37 pods per plant) over closer spacings. Sowing broadbean at widerspacing of S6 (60x15 cm) registered maximum seed yield per plant (17.97 g) being at par with S3 (60x10 cm) and significantly higher over rest spacings. The maximum and significantly higher seed yield (19.49 q/ha) was recorded with planting spacing at 30x15 cm (S4) over other spacings being at par with S1 (30x10 cm) (18.96 q/ha).

EFFECT OF CLIMATE CHANGE WITH SPECIFIC REFERENCE TO AGRICULTURE AND FOOD PRODUCTION

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Abstract

Climate change is a complex alteration of climate, subtle and continuous, yet extremely important through its consequences on vegetation of various types that thrived under constant or relatively unchanged climates. The effects of climate change have reached such an extent that irreversible changes in the functioning of the planet are feared. Some of the main effects of climate



change with specific reference to agriculture and food production especially during the last decade are: increased occurrence of storms and floods; increased incidence and severity of droughts and forest fires; steady spreading out of frost-free intervals and potential growing season; increased frequency of diseases and insect pest attacks; and vanishing habitats of plants and animals.

Apparently, these modifications of previously stable climates imply an obvious warming trend and a growing climatic variability impacting the exiting ecosystem. It is important for the international scientific community to use all accessible knowledge to stop or reverse this trend to the maximum extent possible. There have been various attempts and viable measures in the past to bring down atmospheric greenhouse gases (GHGs) to slow down climate change (Boer *et al.*, 2000). However, if the warning trend continues at its current pace, these may soon prove inadequate. The early impacts of climate change already are being felt worldwide. Future impacts will affect a broad array of human and natural systems, with consequences for human health, food and fiber production, water supplies, and many other areas vital to economic and social well being. While certain impacts may in the nearer prove beneficial to some, in the long-term, the effects will be largely detrimental.

STUDY OF EFFECT OF HYDROMETHANOLIC EXTRACT OF BRAHMI (HMEB), SHATAVARI (HMES) AND THEIR MIXTURE(HMEBS) ON MOTOR PERFORMANCE IN WISTAR RAT.

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Abstract

A study was conducted to evaluate the effect of hydromethanolic extract of Brahmi whole plant, Shatavari root and mixture of Brahmi whole plant and Shatavari root on motor performance in wistar rat (100-150 gm) by using Rota rod apparatus. Experiment was consisting of five groups having six rats in each. Group I was control administered with equivalent amount of vehicle orally for 14 days. Group II and Group III was administered with hydromethanolic extract of Brahmi (HMEB), and Hydromethanolic extract of Shatavari (HMES) @ 400mg/kg bwt orally for 14 days respectively whereas rats of group IV and group V were fed with hydromethanolic extract of mixture (HMEBS) @200 and 400mg/kg bwt orally for 14 days. Effect of HMEB, HMES and HMEBS on motor performance was assessed by rota rod test on 0 day, 7th day and 14th day and in this fall off time were recorded. There is no significant difference was observed in fall-off time of different group at zero day of the experiment. The fall- off time of group I, II, III, IV and V on zero day were 1.80, 1.70, 1.90, 1.76 and 1.80 sec respectively. Motor performance on 7th day found to be significantly highest in group treated with lower dose of HMEBS at the rate of 200 mg/kg b. wt followed by group treated with HMEB, HMES and HMEBS at the rate of 400 mg/kg b.wt. Each group was significantly differed from other. On 14th day, again motor performance of each treatment group was significantly higher as compared with the control group. The value of fall-off time of Group I, II, III, IV and V on 14th day were 2.90, 27.25, 17.85, 36.53 and 21.20 sec respectively. Further on 14th day, also there was significantly increase in fall-off time in group treated with HMEBS at lower dose of 200 mg/kg b. wt. followed by HMEB then HMEBS at higher dose and lastly group treated with HMES at the rate of 400 mg/kg b.wt. From the result of rota rod experiment It may be interpreted that HMEBS at lower dose have highest effect on motor performance. Again, in rota rod experiment, HMEB has better effect on motor performance as compared with HMES on both 7th and 14th days.

AEROPONICS TECHNOLOGY : PRESENTING THE SUSTAINABLE AGRICULTURE MODEL FOR TECHNOLOGY ADOPTION AND INTEGRATION

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Abstract

With aeroponics, plants are grown without the use of soil by misting their roots with a nutrient-rich solution. Aeroponics has been revolutionized by technology, which offers advantages including automatic nutrient supply, environmental management, and plant health monitoring.



A formula called TAISA determines how much technology is integrated into any sustainable farm. system to ascertain the impact of technology on output and quality. According to the systematic research, Industry 4.0 and sensor technology are the most widely used technologies in aeroponics. These technologies have improved time efficiency and sustainability, among other things. On the other hand, the research emphasized that the primary obstacles to technology-assisted aeroponics were technical complexity and power dependency. Lastly, the TAISA model shows that technology has mostly been used to develop new procedures that can only be carried out with its assistance. Thus, we deduce that the application of technology has become established in aeroponics and can be encouraged to improve sustainable agriculture. Controlled Environment Agriculture holds promise as a way to intensify current agricultural production systems while limiting pressures on land, water, and energy resources. To shed light on these considerations and challenges, an instrumented aeroponic system was prototyped to create a quotative growth model for various species of leafy greens. As the first consideration, pressure swirl atomisers were paired with a diaphragm-type pressure tank to supply the necessary pressures needed for effective atomisation. Secondly, the nutrient solution was mixed on demand from Reverse Osmosis water, and the cent rated nutrient stock was then pumped into the pressure tank using a positive displacement pump. A bamboo-based substrate that allowed germination and extended vegetative growth was supported on a stainless-steel mesh and PVC frame acting as a grow tray. Finally, a camera microservice platform was developed using a computer vision pixel-based segmentation method to quantify plant growth.

GENDER MAINSTREAMING IN AGRICULTURE AND RURAL DEVELOPMENT IN INDIA

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Abstract

Gender issues and gender inequality still exist in many countries, especially in remote areas. Rural women often suffer from economic disadvantages, low self-confidence in the family and community. They have limited access to health, social services and extension services which leads to lesser decision-making roles in the production and business of households and in leadership at work. In the context of digital transformation, women were found to be more disadvantaged in comparison with men. Gender mainstreaming activities have only recently become apparent in development efforts but are still limited in development projects. Promoting gender mainstreaming in rural development activities will be necessary to improve the capacity of women towards achieving rural development. Future interventions should pay more attention to building the capacity for women to access more educational and extension services in enabling environments. Institutional monitoring system to track progress in gender mainstreaming in agriculture and rural development will be very important to deliver wider impacts of development programs and projects.

DECONTAMINATION OF CHEMICAL PESTICIDE RESIDUES IN BRINJAL

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Abstract

Various types of chemical pesticide are being used to treat crops for providing protection against different insect pests on different stages of crop growth. The risk of ingesting pesticide residue contaminated vegetables on the health of the general public is a major concern. Majority of the farmers are not really followed the exact recommended dose and time of application when the pests reached Economic Threshold Level. However, vegetables especially brinjal is being widely consumed in India in different forms and also being a good source of minerals, vitamins and essential amino acids which are necessarily required in large quantities for human health. Sucking insect pests like whitefly, thrips and aphids were attacking on brinjal throughout the crop growth period. Imidacloprid 70%WG @ 35g a.i./ha was applied twice through foliar application. Samples were taken at different intervals. Decontamination methods such as washing with 2% NaCl solution, 0.1% baking soda solution as well as



washing with normal water were evaluated. The residues of imidacloprid were determined by using High Performance Liquid Chromatography and it was found to be persisted upto 9th day. Among decontamination methods, washing with 2% NaCl solution was found to be the most efficient as compared to other methods.

EVALUATION OF BIO-CONTROL AGENTS (BCAS) FOR THE MANAGEMENT *MACROPHOMINA* ROOT ROT AND *FUSARIUM* WILT OF CASTOR

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Abstract

Macrophomina root rot and *Fusarium* wilt are the major problems in successful and profitable cultivation of castor at present in India. Castor (*Ricinus communis* L.) is an oldest non-edible oilseed crop which belongs to family *Euphorbiaceae*. It is a major crop among oilseeds and generally grown under varied climatic conditions viz., tropical, subtropical and temperate regions of the world for its highly valued oil. The efficacy of various bio-control agents viz., *Trichoderma viride*, *Pseudomonas fluorescence* and *Bacillus subtilis* were evaluated in combination with each another as seed and soil application during Kharif, 2021 and 2022 at Agricultural Research Station (Agriculture University, Jodhpur), Mandor. Treatments, T₁=Seed treatment with *T. viride* @ 8g/kg seed + soil application of *T. viride* @ 2.5 kg/h enriched in 100kg FYM, T₂=Seed treatment with *P. fluorescence* @ 8 g/kg seed + soil application of *P. fluorescence* @ 2.5 kg/h enriched in 100kg FYM, T₃=Seed treatment with *B. subtilis* @ 8g/kg seed + soil application of *B. subtilis* @ 2.5 kg/h enriched in 100kg FYM, T₄= Seed treatment with *P. fluorescens* @ 8g/kg seed + soil application with *T. viride* @ 2.5 kg/h enriched in 100kg FYM, T₅= Seed treatment with *B. subtilis* @ 8g/kg seed + soil application with *T. viride* @ 2.5 kg/h enriched in 100kg FYM, T₆= Seed treatment with *B. subtilis* @ 8g/kg seed + soil application with *P. fluorescence* @ 2.5 kg/h + *T. viride* @ 2.5kg/h enriched in 100kg FYM and T₇=Control were tested in field condition, Amongst, the lowest incidence of root rot (8.5%) and wilt (9.5%) was recorded in the seed treatment with *Bacillus subtilis* @ 8g/kg seed + soil application with *Pseudomonas fluorescence* @ 2.5 kg/ha + *Trichoderma viride* @ 2.5 kg/ha enriched in 100kg FYM with maximum seed yield (2769 kg/ha and 2815 kg/ha) followed by seed treatment with *P. fluorescens* @ 8g/kg seed + soil application with *T. viride* @ 2.5 kg/ha enriched in 100 kg FYM which was recorded 13.3 per cent root rot and 10.4 percent wilt with 2555 kg/ha and 2765 kg/ha seed yield. Highest incidence of root rot (44.5%) and wilt (44.4%) diseases was observed in control plots. All the treatments were significantly superior over control.

EVALUATION OF SEED RATE OF WHEAT AT DIFFERENT SOWING TIME IN ZONE I-B

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Abstract

A field experiment was conducted during Rabi season of 2021-22, 2022-23 and 2023-24 at Agriculture Research Sub-station, Hanumangarh to evaluate the seed rate of wheat at different sowing time in Zone I-B. The experiment was laid out in split plot design with comprised of three sowing time i.e., 5 November, 20 November and 5 December as main plot treatment and four seed rates i.e., 80, 100, 120 and 140 kg/ha as sub-plot treatment and replicated thrice. Pooled data of three-year experiment revealed that significantly maximum plant height (101.6 cm), spike length (11.6 cm) and test weight (37.1g) of wheat were recorded under 5 November sowing date. Further, highest effective tillers per m² (371.3), grain yield (4626 kg/ha) and B:C ratio (2.74) were observed under sowing date of 20 November. Varying sowing time of wheat has non-significant effect on grains per spike of wheat. However, higher no. of grains per spike (52.1) was observed under sowing date of 20th November. Further, pooled data revealed that maximum plant height (100.2 cm), effective tillers per m² (380.1), grains per spike (53.9), spike length (11.0 cm), test weight (36.4 g), grain yield (4709 kg/ha) and B:C ratio (2.76) were obtained under the seed rate of 120 kg /ha. The interaction effect between sowing time and seed rate on grain yield of wheat was found significant. The higher grain yield of 4843 kg/ha was recorded on 20th November with 140 kg/ha seed rate and it is statistically at par with 20th November with 120 kg/ha seed rate (4806 kg/ha) and 5th November with 120 kg/ha seed rate (4706 kg/ha).



EFFECT OF FEEDING SUGARCANE TRASH-BASED COMPLETE FEED ON GROWTH PERFORMANCE, HAEMATOLOGICAL, BIOCHEMICAL PARAMETERS AND GROWTH HORMONE GENE EXPRESSION IN OSMANABADI GOAT KIDS

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Abstract

Study was conducted to evaluate the effects of feeding sugarcane trash-based complete feed on growth performance, haematological, biochemical parameters and growth hormone gene expression in Osmanabadi goat kids. Osmanabadi goat kids between 3-4 months of age, eighteen (18, 3x6) were selected from the Goat unit and divided in three groups in a Complete Randomized Design (3x6). Control group (C) was provided with Conventional feed, T1 group was fed with Sugarcane-trash 50% + concentrate 50%, and T2 group was fed with Sugarcane-trash 50% + concentrate 50% + 2g cumin kg⁻¹. Results revealed that, there was non- significant difference in body weight and average daily gain of kids due to treatments. There was non- significant difference in haematological and biochemical parameters of kids due to treatments. Control and T2 group, which received the combination of cumin seed, concentrate, and sugarcane trash, were noticeable upregulated the expression level for the growth hormone gene. It is concluded that the complete feed comprising of sugarcane trash 50% + concentrate feed 50% and sugarcane trash 50% + concentrate feed + 2 g cumin kg⁻¹ has exhibited similar growth performance as conventional feeding (control groups) in goat kids without having any adverse effect on health and growth parameters.

MOLECULAR CHARACTERIZATION OF LUMPY SKIN DISEASE VIRUS ISOLATES FROM DOMESTIC YAKS IN HIMACHAL PRADESH, INDIA

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Abstract

Lumpy skin disease (LSD), an infectious transboundary capripox viral disease of cattle, has substantial economic implications resulting from production losses and permanent damage to the skin of affected animals which lowers their commercial value. The causative agent, lumpy skin disease virus (LSDV), is highly host specific and causes disease primarily in cattle and occasionally in water buffalo and wild ruminants. However, in India there is no report of LSDV infection in domestic yaks (*Bos grunniens*), a closely related bovine species. This study was undertaken to genetically characterize lumpy skin disease virus (LSDV) isolates from the domestic himalayan yaks of Himachal Pradesh, India during the 2022 LSD outbreaks. Two LSDV isolates obtained from yaks from Himachal Pradesh using MDBK cells were genetically characterized by amplifying the complete GPCR (LSDV011), RPO30 (LSDV036) and EEV (LSDV126) genes. These amplified genes were cloned, sequenced and genetically and phylogenetically analyzed.

The multiple sequence alignments revealed that LSDV sequences from both domestic yaks and local cattle from the Shimla district, Himachal Pradesh were identical. The phylogenetic analysis of GPCR, RPO30 and EEV gene sequences revealed that LSDV from the yaks and local cattle clustered with the LSDV wild-type strains of sub-cluster 1.2.1 (Middle East/ European lineage) from Africa, Middle East, Europe, Russia and the Balkans, but grouped in a separate cluster and distinct from the dominant LSDV 1.2.2 strain (East African lineage) circulating in India since 2019. Interestingly, the GPCR nucleotide sequence alignment showed that the LSDV from the yaks have a 12-nt deletion similar to that found in contemporary LSDV 1.2.1 wild-type strains. Additionally, the EEV multiple sequence alignment showed a 27-nt insertion (175-201) in LSDV from yaks and cattle which is a signature of all the LSDV wild-type strains of cluster 1.2 (1.2.1 and 1.2.2). The EEV nucleotide sequence alignment results also showed that LSDVs from domestic yaks have one unique mutation (G253A), while two mutations (G178A and A459G) were similar to other LSDV 1.2.1 wild-type strains. Genetic and phylogenetic analysis of LSDVs showed that the LSDV from the yaks in Himachal Pradesh is closely related with the LSDV 1.2.1 wild-type strains (Middle Eastern/European lineage), in contrast to the predominantly circulating LSDV 1.2.2 wild-type strains (East African) lineage in India. Additionally, identical LSDV sequences in yak and cattle provided evidence that domestic yaks can become infected with LSDV circulating in local cattle. Continued monitoring is needed to assess the impact of LSD on yaks and other wild and domestic ruminants in India.



INTEGRATED PEST AND DISEASE MANAGEMENT IN BLACKGRAM

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Abstract

Blackgram is one of the important pulse crops of south India, which plays a major role in supplementing the income of small and marginal farmers. One of the major constraints of traditional blackgram farming is low productivity with the local varieties. In view of this, the Integrated Pest and Disease Management (IPDM) demonstration of black gram (TRCRU-22) was taken up at College of Agriculture, Gangavathi during 2023-24. The technologies viz., seed treatment with Gouch @ 5 ml/kg, use of new strain of bio-fertilizer and bio-agents *Rhizobium*, *Trichoderma* and yellow sticky trap, timely application pulse magic and need based plant protection measures were demonstrated. The timely sowing of blackgram soon after receiving early monsoon rains encouraged the good yield with reduced foliar diseases. The incidence of 5 per cent yellow mosaic was recorded in demonstration field as compared to check (21%). The infestation of aphids, *Spodoptera* and pod borer was noticed below the ETL levels in the IPDM demonstration plots. The technological gaps which showed the differences in the demonstration yield over potential yield. The results showed that, IPDM technologies in blackgram vty., TRCRU-22 recorded higher average yield of 12.20q/ha compared to local check (10.32q/ha) with increased mean yield to the extent of 15.60 per cent over farmers practices. There is scope for wide adoptability of seed treatment, yellow sticky trap and application of flower and pod enhancing pulse magic and need based plant protection practices. The green save bags used for storing of harvested pulse seeds saved the grains from storage losses.

ROLE OF SMART PHONES IN SOLVING FIELD PROBLEMS OF FARMERS RELATED TO PLANT PROTECTION IN KALYAN KARNATAKA

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Abstract

The smart phones are very much accessible and easily understandable to many farmers as mobile phone act as a medium to distribute the agriculture knowledge through images in WhatsApp group. Firstly, the KVK Scientists started the 'UAS R' group involving Scientists, Professors, Experts, Line Department officials, progressive farmers to solve the farmer's field problem through WhatsApp. The individual Raitha Samparka Kendras and Line departments involved in the farmers extension services created WhatsApp groups. The few groups in this region viz., Negila Yogi, Horticulture Solutions, Krushi Mitra, Hasiru Agri, Annadata Sukibhava, Raitha Sethu, Agrochemicals, Organic Agriculture, Raitha Bandhu, RSK's, etc. These WhatsApp group service have gained more popularity for plant protection services from covid period 2019-2020 in Kalyana Karnataka districts. The individual RSK groups an average receives >2000 and other groups approximately get an average >500 field problems in a year, which are solved directly by experts and benefitted to farmers. The images taken in field on the spot sent to concerned group and experts, experienced scientists, extension officers involved in diagnosing the crop related problems and quickly responding to the image wise field problems. Further, the diagnosed reply sent by experts spread to others by farmers club, KVK contact farmers, self help groups and Extension functionaries and which helps to solve the problems in other than KK regions. The major field problems received on plant protection (62%) including weed management, followed by varieties (12%), nutrient management (9%), irrigation and soil management (5%), organic farming (5%) and marketing (3%) in major crops of the region viz., paddy, redgram, cotton, chilli, sunflower, sugarcane, chickpea, onion, groundnut, pomegranate, papaya, tomato, etc. The plant protection and other problems are successfully tackled and the farmers got benefitted by the service as extremely useful for taking right decisions at right time.



A LONGITUDINAL STUDY ON UDDER HEALTH STATUS IN CROSSBRED DAIRY CATTLE

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Abstract

Mastitis is an important disease of dairy cattle, impacting udder health and consequently the quantity and quality of milk. It is important to understand udder health status during different stages of lactation of the cattle. A longitudinal study was conducted in which advance pregnant and subsequently normally calved crossbred cattle (n=20) from an organised dairy farm were selected randomly and followed from day 7th pre-partum till day 180th post-partum. The quarter foremilk samples of the cattle were collected fortnightly from the calving till day 180th post-partum and analysed for Modified California Mastitis Test, somatic cell count and milk culture. The quarter health status was defined on the basis of culture examination, MCMT and SCC as healthy, latent infection, non-specific mastitis and specific mastitis. A total of 940 quarters were assessed across various stages of lactation from day 15th to day 180th post-partum out of which 761 quarters (80.9%) were healthy, 52 quarters (5.6%) had latent infections, 8 quarters (0.8%) had non-specific mastitis and 119 quarters (12.7%) had specific mastitis. The highest occurrence of specific mastitis was observed in early lactation, particularly on the 15th day post-partum (35.0%), while the lowest occurrence of specific mastitis was on 75th day (1.2%). The occurrence of specific mastitis decreased with progression of lactation and it was minimal during the period of peak production (i.e. during the period from day 75 to 120 of the lactation). Non-specific mastitis was uncommon, affecting only 8 quarters throughout the entire study period. There was significant effect of stage of lactation on occurrence of different types of mastitis in cattle [$F(3, 117.72) = 117.72, p < 0.0001$].

IMPACT OF DIVERSE LAND USE SYSTEMS IN SOIL CARBON SEQUESTRATION POTENTIAL IN INCEPTISOLS OF ASSAM, NORTH EAST INDIA

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Abstract

The type of land use system is an important factor that controls Soil Organic Carbon (SOC) levels. Land use changes influence the balance between the rate of input (e.g. plant litter) and output (e.g. SOC mineralization) of soil organic matter (SOM) as a result of alterations in plant community and land management practice. Large variations exist both in physiographic as well as climatic conditions in North-eastern region (NER) of India. Soils of this region are rich in organic carbon due to its typical settings in the phyto-biomass-rich landscape. However, information on field-scale observations in diversified land use system on soil organic carbon (SOC) content and its complex interaction with land-use systems is scanty. Therefore, an attempt was made to estimate SOC content along with carbon sequestration potential of different land use system in a *Typic Dystrudepts* of AAU- Horticulture Research Station, Kahikuchi, Kamrup, Assam of North East India. The primary objective of the current study is to determine the effects of diverse land use systems including Agroforestry based land use system, Palm based land use system, Fruit tree based land use system, flower based land use system and forest based system on soil carbon sequestration of the study area. In this study, soil samples from two different depths (0–30 cm and 30–50 cm) were collected from different land use systems and SOC content was determined along with bulk density. Thereafter soil organic carbon density was calculated out. From the study it was observed that the SOC content ranged from medium to very high. A very high value of 2.39% organic carbon was found in surface soil, i.e. in 0-30 cm depth of pure forest system and the lowest value of 0.60% was found in flower based land use system. Similar trend was also seen in subsurface soil i.e. in 30-50 cm depth, the highest being 0.98% and the lowest 0.37% in pure forest system and flower based system respectively. Soil organic carbon density (SOCD) corresponds the same pattern i.e. highest being found in pure forest system in both the depths (SOCD = 88.91 Mg ha⁻¹ in upper surface and SOCD = 37.29 Mg ha⁻¹ in lower surface) and the lowest in flower based system (i.e. SOCD = 23.58 Mg ha⁻¹ in upper surface and SOCD = 23.58 Mg ha⁻¹ in lower surface). Complex interaction of geographic location, rainfall, soil texture and land-use practices significantly influenced in SOC content, density and stock.



INNOVATIVE PARTNERSHIP APPROACHES FOR RICE SECTOR

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Abstract

Partnerships based on knowledge sharing between scientists and clientele groups are increasingly needed to advance science and for the implementation of science-based information (Born, Boreux, & Lawes, 2009). Partnership is the one of the approach envisaged for achieving the country's committed challenging millennium development goals (MDG) like ensuring food security, reducing rural poverty and improving farm productivity without adverse effects on environment. There is an increasing need to work in partnership and to share knowledge and skills in order to provide locally relevant services that meet the information needs of marginal and smallholder farmers in India (Glendenning, Babu, & Asenso-Okyere, 2010). Partnership as an approach implying the collaborative relationship consisting of research and non-research actors from both public and private sector is gaining significance among the donor agencies and international research community. There is a need to identify the gaps in knowledge at the level of individual partnerships, the level of the organizations that participate in or manage portfolios of partnerships, and the level of research or innovation domains that are characterized by networks of partnerships (Horton, Prain and Thiele, 2009). This paper explores the conceptual basis for existing and emerging institutional patterns of agricultural research and development in general and rice in particular in the context of partnership approaches to technology development and dissemination. Also, it documents the stakeholder's perceptions and willingness in the various partnership processes like rice technology development and dissemination. The paper will also discuss the new patterns of partnership in agricultural research and development leading to possible emergence of a new model for the production, diffusion and use of agricultural technology.

NATURAL FARMING – ITS PRESENCE IN THE PRESENT AGRICULTURE

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Abstract

To uplift the living standard of rural and agrarian communities, Government is focusing on finance by fulfilling their basic needs as agriculture sector is the backbone of the rural & urban growth. But due to delayed and poor monsoons caused by El Nino in the present situations, there is a drop in the food grain production when compare in the past growth rate. We need to create a balance by preparing our farmers to face this situation of crisis and take preparatory measures by including latest technologies in production. Agronomic & Integrated techniques have to be developed on cropping system basis in order to minimize the use of purchased inputs and to increase the use of off farm inputs. The Govt. plans to bring farmers across the country into different smart agricultural practices to meet the present crisis which among them is possible by following Natural Farming. The Government plans to setup 10,000 needs based bio-input resource centers to facilitate this process for small and marginal farmers and also to suit to the diverse conditions within the zone with a higher sustainability.

DECODING YIELD DETERMINANTS: A CORRELATION AND PATH ANALYSIS APPROACH IN CHICKPEA (*CICER ARIETINUM* L.)

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Abstract

A study was conducted using a set of 537 diverse chickpea germplasm lines to assess the correlation and path coefficient analysis for seed yield per plant and its six associated traits. Results indicated that seed yield per plant exhibited a significant positive correlation with both the number of pods per plant and 100-seed weight, while showing a significant negative



correlation with plant height. Among the component traits, days to 50% flowering demonstrated a significant positive correlation with days to maturity, plant height, and the number of pods per plant. Additionally, plant height was positively correlated with days to maturity and the number of primary branches per plant. Conversely, 100-seed weight exhibited a significant negative correlation with all six component traits. Path coefficient analysis revealed that the number of pods per plant had the strongest positive direct effect on seed yield, followed by 100-seed weight, the number of primary branches per plant, and days to maturity. These findings suggest that selecting genotypes based on these traits would be beneficial for improving seed yield potential in chickpea. However, days to 50% flowering and plant height exerted a negative direct effect on yield. The number of pods per plant influenced seed yield indirectly through traits such as days to 50% flowering, days to maturity, and primary branches per plant, indicating that indirect selection via these traits could enhance yield improvement. Consequently, breeding efforts should prioritize traits such as 100-seed weight, number of pods per plant, and number of primary branches per plant to achieve desired improvements in chickpea grain yield.

EFFECT OF FEEDING SUGARCANE TRASH-BASED COMPLETE FEED ON GROWTH PERFORMANCE, HAEMATOLOGICAL, BIOCHEMICAL PARAMETERS AND GROWTH HORMONE GENE EXPRESSION IN OSMANABADI GOAT KIDS

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Abstract

Study was conducted to evaluate the effects of feeding sugarcane trash-based complete feed on growth performance, haematological, biochemical parameters and growth hormone gene expression in Osmanabadi goat kids. Osmanabadi goat kids between 3-4 months of age, eighteen (18, 3x6) were selected from the Goat unit and divided in three groups in a Complete Randomized Design (3x6). Control group (C) was provided with Conventional feed, T1 group was fed with Sugarcane-trash 50% + concentrate 50%, and T2 group was fed with Sugarcane-trash 50% + concentrate 50% + 2g cumin kg⁻¹. Results revealed that, there was non- significant difference in body weight and average daily gain of kids due to treatments. There was non- significant difference in haematological and biochemical parameters of kids due to treatments. Control and T2 group, which received the combination of cumin seed, concentrate, and sugarcane trash, were noticeable upregulated the expression level for the growth hormone gene. It is concluded that the complete feed comprising of sugarcane trash 50% + concentrate feed 50% and sugarcane trash 50% + concentrate feed + 2 g cumin kg⁻¹ has exhibited similar growth performance as conventional feeding (control groups) in goat kids without having any adverse effect on health and growth parameters.

GENOMICS OF MILK MIRNAS AND ITS SIGNIFICANCE IN ANIMAL HUSBANDRY

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Abstract

miRNAs are non-coding ribonucleic acids with the length of 22 nucleotides. They help in gene regulation which involve in biological processes. They have been identified in milk mostly in the lipid layered nanovesicles called as exosomes. bta-miR-26a, bta-miR-148a, bta-miR-27b, bta-miR-21-5p, bta-miR-30a-5p, bta-miR-99a-5p, bta-miR-200a, bta-miR-26c etc, are found in buffalo exosomes. A Significant difference was observed between the late and mid lactation stages for bta-miR-148a and bta-miR-30a expression in buffalo milk exosomes. KEGG pathway analyses predicted that most of the target genes of these buffalo milk microRNA were associated with the PI3K-Akt signalling pathway, breast cancer, Ras signalling pathway, TGF- β signalling pathway and transcriptional dysregulation in cancer. Recent findings suggested that milk is required for optimal growth in infants supporting the development but may have few side effects in adults on persistent consumption (Rani et al., 2020) miRNAs play vital role in the regulation of luteal and follicular development. The expression of miR-221 was studied during -30 days prepartum, 7 days postpartum, and 30 days postpartum period. miR-221 expression was increased in 30 days postpartum corresponding to early lactation. So miR-221 can be linked to endothelial cell proliferation and/or angiogenesis control (Neethirajan, 2022). Overexpression of miR-146a and miR-383 in buffalo milk is



associated with inflammation and subclinical mastitis. Thus, they can be used as markers to diagnose the disease like mastitis where CMT was found negative and somatic cell count was less than 2 lakhs (Jadhav et al., 2024). Iannaccone et al., 2018 explored that the miR-146a can be used as a biomarker in milk infected with Tuberculosis. It could be used as a non-invasive biomarker for detection of tuberculosis in cattle. Thus, miRNA can bring revolutionary change in detection of diseases and thereby bringing preventive measures to enhance dairy production in India.

CONSTRAINTS FACED BY THE MEMBERS OF AGNIGARH PRODUCER COMPANY LIMITED IN MANAGEMENT OF LITCHI ORCHARD

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Abstract

Farmer Producer Company is a company formed by a group of farmers who are producers come together to form a company. The present investigation was conducted out with the objective to identify the constraints faced by the members of Agnigarh Producer Company Limited in management of litchi orchard. Agnigarh Producer Company Limited was selected purposively, as the Farmer Producer Company dealing with commercial litchi production was operating in this district. A sample of 80 respondents was chosen from 13 selected villages in Sonitpur district using a proportionate random sampling method. To identify the constraints faced by the members of FPC in management of litchi orchard, Problem Confrontation Index (PCI) was used which was computed by a 3-point rating Likert type scale. Findings revealed that “High incidence of bats and birds” got the highest score (PCI-217) and hence was the 1st ranked problem of the majority of the respondents. Followed by “Litchi yield loss due to weather condition” which got the 2nd highest scores (PCI-200) and hence ranked as the 2nd major problem. “High cost of labour” was another problem faced by members of Agnigarh Produce Company Limited in management of litchi orchard which was ranked third on the basis of the 3rd highest score (PCI-199). “Scarcity of labour in time” was ranked 4th among problems faced by the respondents while with a PCI score-189. “Lack of irrigation facility” got the 5th rank among the problems based on the score of PCI-178 as mentioned by the respondents. Findings revealed that the respondents could not manage the litchi orchard properly due attack of bats and birds. Therefore, the concerned forest department along with the litchi growers should take necessary actions to control the damage caused by the bats and birds in the litchi orchards. ‘High cost of labour’, ‘high cost of good quality inputs’ was the major constraints faced by the members of FPC in management of litchi orchard. Hence, the concerned FPC should initiate steps to supply to their members of FPC good quality inputs in right time and in reasonable price.

ENHANCING GENETIC DIVERSITY IN FINGER MILLET (ELEUSINE CORACANA) THROUGH GAMMA IRRADIATION FOR BLAST DISEASE RESISTANCE AND YIELD IMPROVEMENT

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Abstract

Finger millet (*Eleusine coracana*), a nutrient-rich cereal of the Poaceae family, is widely cultivated in arid and semi-arid regions of Africa and South Asia for its adaptability to harsh conditions. In a study exploring gamma irradiation's effects, 41,032 M2 mutants were screened for blast disease resistance and yield traits, resulting in the selection of 125 mutants. These were advanced to the M3 generation, where seven lines were highly resistant (HR) to leaf, neck, and finger blast, including promising lines M3_400Gy_62, M3_450Gy_84, and M3_450Gy_101, which also exhibited superior yield attributes. The antioxidant enzymes (Peroxidase and Superoxide dismutase) activity were also analysed from 20 selected M3 lines along with Rajendra Madua 1, resistant and susceptible checks. The results showed that antioxidant enzymes activity were maximum in HR followed R, MR, S and HS. Further, 15 selected M3 mutants along with Rajendra Madua 1, resistant and susceptible checks were characterized using SSR marker. SSR markers were used characterization of mutant lines. Numerous studies have



demonstrated the effectiveness of Plant Growth-Promoting Rhizobacteria (PGPR) in significantly suppressing blast disease development. In particular, treatments such as T3 (PGPR1 + PGPR2), T5 (5% Vermicompost + PGPR1), and T7 (PGPR1 + PGPR2 + 5% Vermicompost) achieved the lowest Percent Disease Index (PDI) at 20.7%, 8.8%, and 4.44%, respectively. These treatments also enhanced growth parameters, including root length, shoot length, stem thickness, finger length, and the number of fingers per ear. These findings underscore the potential of integrating PGPR with vermicompost for eco-friendly and holistic management of blast disease in finger millet.

FOOD PROCESSING & VALUE ADDITION IN MINOR FRUITS

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Abstract

India enjoys a prominent position on the pomological map of the world. The varying weather conditions of this country provide suitable environment for growing a variety of fruits. These fruits are available in abundance and also in different seasons. This has resulted in limited scope for expansion of other minor fruits, though they are nutritious, and are the main source of livelihood for the poor. Most of the underutilized fruits of the tropics are often available only in the local markets and are practically unknown in other parts of the world. A large number of these fruits can grow under adverse conditions and are also known for their therapeutic and nutritive value and can satisfy the demands of the health-conscious consumers. However, some of these fruits are not acceptable in the market in fresh form due to their acidic nature and astringent taste. Hence, there is a need to concentrate on research efforts in diversification and popularization of such underutilized fruit crops. To achieve this, there is a need to create demand for such fruit crops in the domestic and international markets. This, to some extent, can be achieved through developing suitable processing and marketing strategies for these underutilized fruits.

EVALUATION OF MULBERRY GENOTYPES FOR GROWTH, LEAF YIELD AND QUALITY CHARACTERS UNDER SUB-TROPICAL CONDITIONS OF JAMMU

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Abstract

Mulberry (*Morus* spp.) is the only food source of silkworm (*Bombyx mori* L.). With the increasing demand of silk in the domestic and global markets, it is necessary to develop high yielding mulberry varieties for production of more cocoons and silk. Mulberry leaves with superior quality and higher yield are the essential requirements for quality cocoon production. Development of high yielding mulberry varieties through various breeding methods is a continuous process and is mainly based on indirect selection for yield and growth characters. The present study comprising seven mulberry genotypes viz., PPY-3, PPY-6, PPY-7, A-6, A-9, D-33 and S-106 along with three check varieties S-146, C-2038 and G-4 were planted and maintained in Randomized block design at Regional Sericultural Research Station, Central Silk Board, Miran Sahib, Jammu. All the mulberry genotypes were evaluated for various growth, leaf yield and quality parameters during Autumn season 2023 under sub-tropical conditions of Jammu. Analysis of variance for growth and yield contributing characters showed highly significant differences among the genotypes. Among the genotypes, leaf yield per plant was highest in PPY-6 (0.662 kg) followed by PPY-3 (0.616 kg) and PPY-7 (0.504 kg) and out performed as compared to three check varieties. Total shoot length per plant was significantly higher in PPY-3 (1110 cm) followed by PPY-6 (1060 cm) and A-9 (967 cm) and out performed as compared to three check varieties. Similarly, number of leaves per meter of shoot was higher in D-33 (26) followed by A-6 (23) and PPY-6 (22). Leaf moisture content (%) was highest in PPY-6 (75.31%) followed by PPY-3 (73.07%) and PPY-7 (72.34%). Based on this evaluation study, PPY-6 and PPY-3 out performed for different growth, yield and quality characters as compared to check varieties, which may be further evaluated under different seasons and may be commercially



exploited for production of higher leaf yield and better quality mulberry leaves under sub-tropical conditions of Northern India.

EFFECTS OF INTERCROPPING AND INTEGRATED NUTRIENT PRACTICES ON OATS AND BERSEEM FODDER YIELD AND QUALITY

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Abstract

Livestock productivity can be significantly impacted by a shortage of green fodder, particularly when the fodder is of inferior quality. To address both the quantity and quality demands of fodder, adopting intercropping practices and integrated nutrient management strategies may prove crucial. A factorial randomized block design was utilized to lay out the experiment with four-row ratios in intercropping and four nutrient management treatments with three replications of each. Results revealed the significantly highest green fodder yield of oats (24.7 and 12.8 t ha⁻¹) and berseem (13.3 and 13.8 t ha⁻¹) in treatment oats alone (IC₁) and berseem alone (IC₂). Cultivation of oats alone and berseem alone recorded significant superiority for individual crop yield over intercropping in IC₃ (2:1) and IC₄ (1: 2) oats and berseem row ratios. Highest total green fodder yield (37.6 t ha⁻¹) and dry fodder yields (6.7 t ha⁻¹) both the crops were recorded highest in oats alone (IC₁) and found at par with intercropping in (IC₃) 2:1 row ratio of oats and berseem. Among the different integrate nutrient practices, the highest total green (38.35 t ha⁻¹) and dry fodder (6.41 t ha⁻¹) yields of oats and berseem were recorded with treatment NM₄. Intercropping of oats and berseem in 2:1 row ratio recorded improved proximate composition, feed quality and lower fiber fractions compared to 1:2 oats and berseem row ratio. Whereas treatment NM₄ recorded higher values of proximate composition, feed quality and lower values of fiber fractions over remaining treatments. Hence, it can be concluded that intercropping and integrated nutrient practices through the combined application of PGPR and seaweed extract along with mineral fertilization significantly play a vital role in improving the yield, proximate composition, fiber fraction, and feed quality of oats and berseem crops.

RICE-BASED GLUTEN FREE MULTI-COMPOSITE COOKIES: CHARACTERIZATION OF A NEW PRODUCT

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Abstract

The demand for gluten-free products has surged in recent years due to increasing awareness of gluten intolerance and the health benefits associated with gluten-free diets. This study focused on developing a novel, gluten-free, nutrient-rich rice-based cookie using NRRI's specialty high-zinc rice variety, CR Dhan 315. Five different formulations were tested, incorporating various ratios of rice flour, bajra, sorghum, and finger millet. The objective was to create a gluten-free cookie with acceptable sensory attributes while enhancing its nutritional profile. Two control samples were included for comparison: one made with 100% wheat flour and the other with 100% rice flour.

The physical properties of the cookies were evaluated based on weight, diameter, thickness, color, texture, and spread factor. The optimization process aimed to achieve the best balance of these parameters, ensuring both quality and consumer acceptability. Sensory evaluation was conducted to assess the taste, texture, and overall appeal of the cookies, with the formulation containing a balanced mix of rice and millet flours showing the best results.

Nutritional analysis of the optimized cookie sample revealed a favorable proximate composition, with significant improvements in protein, fiber, and zinc content due to the inclusion of high-zinc rice and millet ingredients. The results demonstrated that the developed gluten-free rice-based cookies not only provided a healthy and nutritious alternative to traditional wheat-based cookies but also offered an appealing option for individuals seeking gluten-free dietary choices. This research contributes to the diversification of gluten-free snack options with enhanced nutritional benefits.



REVERSE BREEDING : A NOVEL BREEDING APPROACH FOR CROP IMPROVEMENT

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Abstract

Several New Plant Breeding Techniques (NPBT) have been developed in last two decades and evolved rapidly in recent years among them reverse breeding is one. Reverse Breeding (RB) is a novel Plant Breeding technique designed to directly produce parental lines for any heterozygous plant, one of the most sought after goals in plant breeding (Dirks *et al.* 2009). It has been tested in Arabidopsis by wijnker *et al.* 2012. Reverse breeding starts with a heterozygous line and aims at the generation of homozygous parental lines. First, meiotic recombination is suppressed than haploid microspores harvested and will subsequently be doubled using a laboratory techniques called doubled haploid technology. Complementary Parents can be selected and used reconstitute original heterozygote. As a breeding tool, reverse breeding may be regarded more versatile as its controlled deconstruction of complex genotypes into homozygous parental lines allows the further improvement of these lines by classic breeding methods. Novel breeding approach accelerates the breeding process. The fixation of unknown heterozygous genotypes is impossible in traditional plant breeding. Reverse Breeding could fundamentally change future plant breeding. It Increases the available genetic combinations and Production of new hybrid plant varieties in a much short time frame. Hybrid does not contain any genetic modification so it is safe for environment and used for food and feed production

HARNESSING BIOINFORMATICS FOR ADVANCEMENTS IN PLANT BREEDING

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Abstract

In recent years, the integration of bioinformatics in plant breeding has revolutionized the way we approach crop improvement. This presentation explores the pivotal role of bioinformatics in enhancing the efficiency and precision of plant breeding techniques. By leveraging advanced genomic sequencing, marker-assisted selection, and gene editing tools, bioinformatics provides invaluable insights into genetic diversity and trait selection. We will delve into key bioinformatics tools and their applications, such as identifying genetic markers, improving crop yield, and developing stress-resistant varieties. Through case studies, we will illustrate successful applications in rice breeding and the creation of drought-resistant crops. Additionally, we will address the challenges of data management, ethical considerations in genetic modification, and the future prospects of bioinformatics in plant breeding. This presentation aims to highlight the transformative impact of bioinformatics on plant breeding and its potential to ensure global food security in the face of climatic and environmental challenges.

COMPLETE GENOME ANALYSIS OF AFRICAN SWINE FEVER VIRUS ISOLATED FROM DOMESTIC PIG IN MIZORAM, INDIA: A FIRST REPORT

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Abstract

This study presents the first complete genomic characterization of African swine fever virus (ASFV) isolated from domestic pigs in Mizoram, India. Real-time qPCR detected ASFV in 38 out of 41 samples collected from multiple districts across Mizoram. Virus isolation using porcine alveolar macrophages confirmed hemadsorption, and the isolates were propagated for sequencing. Next-generation sequencing of an isolate from domestic pig yielded a high-coverage complete genome of 189,390 bp. Comparative genomic analysis revealed approximately 99% nucleotide identity among Indian ASFV isolates,



with the discovery of a unique tandem repeat sequence (TRS) in the intergenic region, aligning these isolates with genotype II strains reported in China, Germany, and Vietnam. Notably, the study identified unique non-synonymous single nucleotide polymorphisms (SNPs) in immune-modulatory genes, including K205R, E199L, and EP1242L, distinguishing them from previously reported Indian isolates and highlighting the ongoing evolution and genetic diversity of ASFV in India. Phylogenetic analysis placed the Indian isolates within clade 2.2.2 of genotype II, closely related to strains from Europe and Asia. Furthermore, serogrouping based on the EP402R gene confirmed their alignment with serogroup 8, consistent with an intact hemadsorption phenotype. This study underscores the presence of unique genomic features in Indian ASFV isolates, emphasizing the importance of investigating the functional implications of these mutations on the virus's pathogenesis and immune evasion strategies.

PLANT DYNAMICS AND PRODUCTIVITY OF PINEAPPLE INFLUENCED BY MULCHING AND NUTRIENT MANAGEMENT UNDER NEEM BASED AGROFORESTRY SYSTEM

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Abstract

The present study was carried out at the experimental plot of All India Co-ordinated Research Project on Agroforestry, Odisha University of Agriculture and Technology (OUAT), Bhubaneswar during 2021-23. The experiment was carried out in Split Plot Design (SPD) with three mulching treatment i.e. M₁ (White polythene mulch), M₂ (Black polythene mulch), M₃ (Trash mulch) in main plot and four sub plot treatment including nutrient management (N: P₂ O₅ :K₂O:: Kg/ha) i.e., F₁: 16:8:16, F₂: 12:6:12, F₃: 10:5:10 and F₄: 0:0:0. The row to row distance of Neem plant was 8mt and plant to plant distance was 2mt. Pineapple cv. Queen were placed at a spacing of 80 x 60 cm² in the interspaces of four year old Neem plant lines. During the growth period highest plant height (6.0 m), DBH (10.6 cm) and crown spread (3.55 m) of Neem was recorded with F₁: 16:8:16 (N:P₂ O₅ :K₂O:: Kg/ha) in M₂ (Black polythene mulch). The biometric observation of pineapple plant such as plant height (92.77 cm), D-leaf length (66.22 cm) and number of leaves (47.31) were observed highest in F₁: 16:8:16 (N:P₂ O₅ :K₂O:: Kg/ha) and similar trend also followed in M₂ (Black polythene mulch). Pineapple fruit length (17.50 cm), fruit girth (35.93 cm) and fruit weight (1104.56 gm) was recorded highest in F₁: 16:8:16 (N:P₂ O₅ :K₂O:: Kg/ha) with M₂ (Black polythene mulch). The yield (16.12 t ha⁻¹) of pineapple crop gross return of Rs. 4.83 lakh ha⁻¹ and net return of Rs. 2.98 lakh ha⁻¹ and BCR 2.61 were recorded highest in M₂ (Black polythene mulch).

EFFECT OF SPACING AND NIPPING ON GROWTH AND YIELD OF CHICKPEA (*CICER ARIETINUM* L.) UNDER RAINFED CONDITION OF SUB AGRO CLIMATIC ZONE-VI

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Abstract

The field experiment entitled “Effect of spacing and nipping on growth and yield of chickpea” was conducted at Zonal Research Station, Darisai, East Singhbhum, Birsa Agricultural University, Ranchi, Jharkhand during *rabi* season of 2022 and 2023 to study the effect of spacing, nipping and also to find out the suitable combination of spacing and nipping for maximizing yield of chickpea in medium land under rainfed condition of sub agroclimatic zone-VI. The treatments were laid out in split plot design and each replicated thrice. The experimental treatments comprised of three spacing i.e., S₁- 30 cm, S₂- 40 cm, S₃- 50 cm in main plot and three nipping i.e., N₁- No nipping, N₂-One nipping at 30 DAS, N₃- One nipping at 40 DAS in sub plot. The results revealed that the significantly higher seed yield (17.25 q/ha) of chickpea was recorded under the treatment - one nipping at 40 DAS whereas, the minimum seed yield (13.92 q/ha) was recorded under treatment- no nipping with spacing of 30 cm. The maximum Net return (Rs.67246/ha) and B:C ratio (2.52) were recorded under treatment - one



nipping at 40 DAS followed by treatment - one nipping at 30 DAS which gave net return and B:C ratio of Rs.64702/ha and 2.50 respectively.

EFFECT OF IRRIGATION LEVELS AND MULCHES ON PHYSIOLOGY OF AMERICAN COTTON

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Abstract

The study aims to assess the effect of irrigation levels and mulches on the physiology of American cotton in Arid Western Rajasthan. The present study on American cotton was undertaken using 'RCH-650 BG-II' variety with five level of irrigation (0.30 PE, 0.45 PE, 0.60 PE, 0.75 PE through drip irrigation and 0.75 IW/CPE ratio through surface irrigation) and four mulches (no mulch, dust mulch, straw mulch and polythene mulch). At different growth stages, net photosynthesis (Pn, $\mu\text{mol CO}_2 \text{ m}^2/\text{s}$), stomatal conductance (C, $\text{mmol H}_2\text{O m}^2/\text{s}$), internal leaf CO_2 (Ci, $\mu\text{mol/mol}$) and rate of transpiration (E, $\text{mmol H}_2\text{O m}^2/\text{s}$) were measured on the fully expanded fourth leaf from top of each plant using IRGAs Portable Photosynthesis System (Model-340, CID Bio-Sciences, Camas, WA). Pooled mean results showed that irrigation at 0.75 PE gave significantly higher net photosynthesis (Pn, $\mu\text{mol CO}_2 \text{ m}^2/\text{s}$), stomatal conductance (C, $\text{mmol H}_2\text{O m}^2/\text{s}$), internal leaf CO_2 (Ci, $\mu\text{mol/mol}$) and water use efficiency as compared to 0.30, 0.45 PE and 0.75 IW/CPE ratio, but it was at par with 0.60 PE. Whereas, higher rate of transpiration (E, $\text{mmol H}_2\text{O m}^2/\text{s}$) was observed in crop irrigated with 0.75 IW/CPE ratio through flood irrigation. Among mulch treatments, straw mulch recorded highest net photosynthesis (Pn, $\mu\text{mol CO}_2 \text{ m}^2/\text{s}$), stomatal conductance (C, $\text{mmol H}_2\text{O m}^2/\text{s}$), internal leaf CO_2 (Ci, $\mu\text{mol/mol}$) and water use efficiency as no mulch, dust mulch and polythene mulch. Whereas, higher rate of transpiration (E, $\text{mmol H}_2\text{O m}^2/\text{s}$) was observed in no mulch plots.

PHENOLOGICAL GROWTH STAGES OF ROSE APPLE (*SYZYGIUM JAMBOS*) IN WEST BENGAL

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Abstract

The Rose apple (*Syzygium jambos*) is a tropical fruit from the Myrtaceae family, commonly grown in India's tropical and subtropical regions, with fruits available in summer. It holds high nutritional value, has a unique rose-like flavor, and is especially beneficial for pregnant women by addressing iron and vitamin deficiencies. Additionally, its seeds and leaves have medicinal uses for treating asthma and fever, while the fruit supports brain health and cognitive function. Despite its popularity, organized cultivation of the Rose apple is limited; it is mostly found in homestead gardens in areas like South and North 24 Parganas, Nadia, and Birbhum in West Bengal, where limited information hinders wider cultivation. A study was conducted during 2022 and 2023 at Mondouri Research station, Nadia under Bidhan Chandra Krishi Vishwavidyalaya, using the BBCH scale to identify the various growth stages of the Rose apple. In this study, seven (7) principal and thirty-nine (39) secondary growth stages were recorded. During late February, the appearance of vegetative bud stages three (3) was observed and overlapping vegetative and reproductive stages were observed in Rose apple. The bud development stage lasts 15-16 days from 1st week of March, followed by a four-week leaf development stage. During the season, the Rose apple tree undergoes 3-4 vegetative flushes, with the first phase of shoot development taking around seven weeks. Inflorescence development completes in three weeks, while flower development takes 12-15 days, coinciding with shoot and fruit growth stages. The fruit development stage lasts approximately six weeks. This study provides crucial insights for Rose apple growers, helping them to execute the crop management like nutrient management, pest control, crop regulation, and harvesting in exact time. It also aids breeders by providing a comprehensive growth timeline to support crop improvement programs.



MANAGEMENT OF *CALLOSOBRUCHUS ANALIS* THROUGH TRADITIONAL AND MODERN APPROACHES: A REVIEW FOR PEST CONTROL IN PULSE PRODUCTION

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Abstract

Pulses are an essential source of protein, accounting for 20-30% of the global dietary protein intake. However, they are highly vulnerable to insect infestations, particularly from bruchid beetles, which pose a significant threat to stored pulses and agricultural production in tropical and sub-tropical areas. *Callosobruchus analis* (F.), commonly known as the cowpea weevil, is one of the most damaging pests affecting seeds of pulses like chickpea, cowpea, soybean, and peanut. The female beetles lay eggs on developing seeds within pods and on stored seeds, leading to damage that reduces both seed quality and quantity. Traditionally, chemical pesticides have been used to control bruchids and other pests, but their excessive use has caused environmental damage, the development of pesticide-resistant pest strains, and health risks for agricultural workers, including oxidative stress, respiratory issues, and neurological disorders. This underscores the need for safer and more sustainable pest control alternatives. This review explores both traditional and modern methods for managing bruchid infestations, particularly *Callosobruchus analis*. It covers approaches such as sealed storage containers, intercropping, the use of alternative host plants, optimizing harvest timings, and maintaining cleanliness. Additionally, the review discusses innovative techniques like freezing and heating treatments, microbial control, botanical extracts and essential oils, transgenic approaches, cold plasma treatments, and radiation. These alternative strategies provide effective, eco-friendly solutions for controlling pulse beetle populations, ensuring better protection of pulses while reducing dependency on harmful chemicals. By adopting these diverse pest management practices, we can foster more sustainable and safer methods of pulse production.

BIOEFFICACY OF DIFFERENT INSECTICIDE FORMULATIONS AGAINST BROWN PLANT HOPPER IN RICE CROP

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Abstract

Brown plant Hopper (*Nilaparvata lugens*) causes serious insect-pest problem during Kharif season. The field experiment was conducted at Research Cum Instructional Farm at IGKV, Raipur (C.G.) during Kharif 2023 to evaluate relative efficacy of insecticides, Pymetrozine 50% WG (200 gm/ha, 300 gm/ha and 350 gm/ha), Dinotefuran 20% SG and Flonicamid 50% WG against brown planthopper infesting rice crop. Pymetrozine 50% WG @ 350 gm/ha recorded significantly the lowest brown plant hopper per hill population (3.54 nymphs and adults/hill) and was at par with Pymetrozine 50% WG @ 300 gm/ha (3.86 nymphs and adults/hill). However, the highest population was recorded in untreated control (17.75 nymphs and adults per hill). Per cent reduction of brown plant hopper (BPH) population over control was ranged from 64.44 to 80.04% in various treatments. The overall maximum BPH population reduction was recorded in plot treated with Pymetrozine 50% WG @ 350 gm/ha (80.04%) followed by Pymetrozine 50% WG @ 300 gm/ha (78.25%). The grain yield was varied between 21.43 to 27.45 Q/ha. The treatment, Pymetrozine 50% WG @ 350 gm/ha recorded significantly higher yield i.e. 27.45 Q/ha and was at par with Pymetrozine 50% WG @ 300 gm/ha (26.89 Q/ha). Untreated control recorded the lowest yield of 21.43 Q/ha.

EFFECT OF PHOSPHORUS LEVELS FOR HIGHER PRODUCTIVITY OF PULSES

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Abstract

Phosphorus, the second major nutrient after nitrogen, is essential for plant energy production and reproduction, including



grain formation. As a key component of nucleic acids, phosphorus significantly impacts growth, metabolism, and soil fertility. However, phosphorus is often a limiting nutrient in Indian soils due to low recovery efficiency (10–30%) caused by its conversion into insoluble forms (Swarup, 2002). Singh *et al.* (2014) reported maximum grain (1.75 t ha⁻¹) and straw (3.9 t ha⁻¹) yields in lentil using 60 kg P₂O₅ ha⁻¹ as rock phosphate combined with molybdenum and *Pseudomonas striata*. Munda *et al.* (2013) recorded the highest soybean grain yield (1.56 t ha⁻¹) and protein content (38.89%) with rock phosphate and biofertilizers. For black gram, Jamra *et al.* (2017) observed significantly higher grain (677.6 kg ha⁻¹) and straw yields (1443.4 kg ha⁻¹) using 60 kg P₂O₅ ha⁻¹ as SSP plus N₃₀ K₃₀. Similarly, Jan *et al.* (2012) found better growth and yield in chickpea at 80 kg P₂O₅ ha⁻¹. Agarwal *et al.* (2007) reported that 60 kg P₂O₅ ha⁻¹ increased pea grain yield by 97.4%, promoting nodulation, N₂ fixation, and root development. Martin *et al.* (2017) showed that 33 mg P₂O₅ kg⁻¹ soil with *Rhizobium* and PSB improved yield attributes in a pot study. Deshbhratar *et al.* (2010) achieved maximum grain yield (12.65 q ha⁻¹) in pigeon pea with 50 kg P₂O₅ ha⁻¹ as DAP. Jahish *et al.* (2017) noted that 60 kg P₂O₅ ha⁻¹ produced the highest mung bean grain yield (1.61 t ha⁻¹) and leaf area index. Thus, phosphorus application (40–60 kg P₂O₅ ha⁻¹) enhances productivity, grain quality, and soil health, improving pulse yields by up to 97.4%.

SEED MEAL QUALITY ASSESSMENT OF *BRASSICA CARINATA* GERMPLASM: INSIGHTS INTO NUTRITIONAL AND FUNCTIONAL DIVERSITY

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Abstract

The assessment of seed meal quality in *Brassica carinata* germplasm is crucial for identifying nutritionally superior genotypes for breeding and industrial applications. This study evaluated starch, soluble sugars, soluble proteins, reducing sugars, non-reducing sugars, and total phenols across 45 accessions of *B. carinata* germplasm. Significant variability was observed among the accessions, highlighting potential candidates for improvement programs. Starch content ranged from 64.8 mg/g (DRMRIC 20-56) to 538 mg/g (DRMRIC 20-59), with promising genotypes such as DRMRIC 20-26, DRMRIC 20-27, DRMRIC 20-30, DRMRIC 20-40, and DRMRIC 20-59 exhibiting high starch levels (>300 mg/g). Soluble sugar content varied between 27.33 mg/g (DRMRIC 20-12) and 144.67 mg/g (Pusa Swarnim), with eight genotypes, including Pusa Swarnim and DRMRIC 20-32, exceeding 100 mg/g. Soluble protein content was highest in DRMRIC 20-56 (167.6 mg/g) and lowest in DRMRIC 20-62 (46.4 mg/g), with seven genotypes surpassing 140 mg/g. Reducing sugars ranged from 0.58 mg/g (Pusa Swarnim) to 25.82 mg/g (DRMRIC 20-11), with six genotypes exceeding 10 mg/g. Non-reducing sugars ranged from 11.51 mg/g (DRMRIC 20-11) to 140.23 mg/g (Pusa Swarnim), and six genotypes, including DRMRIC 20-20 and DRMRIC 20-34, exceeded 100 mg/g. Total phenol content varied from 0.37% (DRMRIC 20-41) to 3.22% (DRMRIC 20-58), with DRMRIC 20-3, DRMRIC 20-56, DRMRIC 20-58, and DRMRIC 20-61 recording high levels (>2.5%). The identified genotypes with superior nutritional attributes offer significant potential for developing high-value *B. carinata* cultivars tailored for food, feed, and industrial uses. These findings provide critical insights for the sustainable utilization of *B. carinata* genetic resources.

NUTRITIONAL VALUE AND HEALTH-BOOSTING PROPERTIES OF RED WEAVER ANT EGGS

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Abstract

The Red Weaver Ant (*Oecophylla smaragdina*), a social insect from the family Formicidae, thrives in tropical fruit plants. In the tribal communities of Mayurbhanj, this species is a popular dietary item, often prepared as “kai chatuni” and enjoyed regularly. Mayurbhanj received a GI-Tag for this chutney in January 2024. Additionally, the tribes use this ant species in traditional medicine to treat ailments such as colds, fever, jaundice, digestive issues, whooping cough, and to boost appetite. The nutritional composition of Red weaver Ant egg (*O. smaragdina*) includes Carbohydrate 10.05 ± 0.60g, Protein 5.46 ±



0.98g, Crude fat 3.46 ± 0.36 g and Crude Fiber 1.38 ± 0.20 g per 100g fresh weight. The mineral composition of Red weaver Ant egg includes Na (600.0 ± 12.3), K (340.0 ± 10.1), P (426.0 ± 10.0), Ca (163.40 ± 2.5), Mg (46.50 ± 1.02), Mn (0.64 ± 0.05), Fe (0.80 ± 0.03), Cu (0.33 ± 0.01) and Zn (4.22 ± 0.2) mg/100g fresh weight. Water-soluble and fat-soluble vitamins content were retinol (4.7 ± 0.2), tocopherol (17.4 ± 0.5), thiamine (10.23 ± 0.78) riboflavin (6.3 ± 0.2), niacin (41 ± 1.6) and ascorbic acid (12.2 ± 0.1) mg/100g of fresh ant. The tannin and phytic acids were detected in the ant eggs where as formic acid was absent. Tribal communities collect these ants for commercial purposes, selling them in local markets at Rs.10 per 100g pouch. The species' nutritional and medicinal benefits indicate that the Red Weaver Ant egg could provide an alternative source of food and medicine for people. The Indigenous techniques of utilizing edible insects should be conserved before vanishing from different tribal culture and the scientific evaluation of these species can direct to build a new era of healthy and prosperous life.

HYBRID CHC MODEL FOR EFFECTIVE FUNCTIONING OF CUSTOM HIRING CENTERS MODELS IN INDIA

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Abstract

India's agriculture is continuously shifting from using automated power to manual labour. This much-needed shift lowers the costs associated with caring for animals and hiring labour, which directly boosts crop output, eliminates drudgery, and facilitates crop-related operations within a time-bound framework. The study was undertaken in Madhya Pradesh and Telangana States. Two erstwhile districts namely Mahabubnagar and Nalgonda districts in Telangana state and Tikamgarh and Guna districts in Madhya Pradesh were selected for the study. Based on the findings of the study a hybrid CHC model and strategy has been developed. For the effective functioning of Custom Hiring Centers the Government, Extension officials, CHC personnel should work cooperatively with truth and equal justice and without bias and political inference. The government should improve the easy accessibility of farm machinery and road/transport facilities in the locality for easy and timely movement of machinery. The government should develop an ICT App named "CHC App" and ensure all the operating CHCs available in it for easy and timely availability of CHC machinery to farmers. Entrepreneurs should make availability of more frequently used machinery in CHC. Machines with low demand should be replaced by machines with high demand. The results of the study are useful helpful for all the stakeholders in modifying their strategies for effective functioning of CHCs.

HORTICULTURE, AGROFORESTRY AND IMPACT OF CLIMATE CHANGE ON BIODIVERSITY AND FOOD SECURITY

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Abstract

The agricultural sector plays a vital role in sustaining the livelihoods of millions of farmers in India. However, it faces persistent challenges due to diseases, pests, and inefficiencies in post-harvest practices that significantly reduce productivity and profitability. This study focuses on advancing sustainable approaches to disease and pest management, enhancing post-harvest technology, and promoting value addition in agricultural produce to augment farmers' income. Using Indian mustard (*Brassica juncea*), a major oilseed crop in India, as a model system, the study integrates modern breeding techniques, pest control strategies, and value-chain interventions to address these challenges holistically. The research begins by exploring the genetic architecture of Indian mustard to identify traits associated with resistance to biotic stressors, such as fungal diseases and insect pests. Marker-assisted selection and genomic tools are employed to accelerate the development of high-yielding, stress-tolerant varieties. Simultaneously, integrated pest management (IPM) strategies, combining biological control agents, eco-friendly pesticides, and crop rotation practices, are evaluated for their effectiveness in reducing pest infestation while minimizing environmental impact. In the realm of post-harvest technology, innovative techniques for seed storage, oil extraction and byproduct utilization are assessed to maximize the efficiency of processing systems. Advanced methods such as cold-press extraction and optimized storage conditions are shown to improve oil quality, extend shelf life and



reduce post-harvest losses. Additionally, food processing and value addition interventions, including fortified mustard oil and seed-based products, are examined for their potential to increase market value and consumer demand. The study underscores the critical role of sustainable management practices in bridging the gap between agricultural production and profitability. By integrating advancements in pest and disease management, post-harvest technology, and value addition, this research demonstrates a pathway toward higher farmer incomes, reduced environmental footprints, and enhanced agricultural resilience. These findings contribute to the broader goal of achieving food security and rural prosperity in the context of climate change and resource constraints.

DEVELOPING DISEASE-RESISTANT BRASSICA JUNCEA: INSIGHTS FROM A NOVEL RECOMBINANT INBRED LINE POPULATION FOR WHITE RUST RESISTANCE

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Abstract

Brassica juncea (L.) Czern & Coss, commonly known as Indian mustard, is a vital oilseed crop in India. However, its production is often hindered by abiotic and biotic stresses, with white rust (*Albugo candida*) being a major biotic threat. This disease, caused by a biotrophic oomycete pathogen, leads to substantial yield losses. Developing high-yielding, disease-resistant mustard varieties is therefore a critical breeding objective. Recombinant Inbred Line (RIL) populations serve as a powerful resource for genetic improvement, providing stable materials for studying complex traits, including disease resistance and yield attributes. In this study, a novel RIL population was developed by crossing the East European genotype 'Heera' with the high-yielding Indian mustard variety 'DRMRIJ-31' using the single seed descent method. The population, comprising 320 RILs, was evaluated over two cropping seasons (2021–22 and 2022–23) for resistance to white rust. Disease resistance traits, including resistance reactions, disease scores, and percent severity index, revealed significant variation within the population. To complement field evaluations, molecular screening was performed using an intron polymorphic marker (AcB1-A4.1) linked to white rust resistance. This analysis identified 100 RILs carrying the resistance allele. A strong correlation between field screening results and molecular marker data highlights the marker's reliability in predicting resistance to white rust. The insights gained from this study provide a valuable foundation for breeding programs aimed at improving disease resistance and crop resilience in *B. juncea*.

ASSESSMENT OF ATTITUDE AND CONSTRAINTS AMONG FARMER PRODUCER ORGANIZATION MEMBER FARMERS IN SOUTH GUJARAT

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Abstract

India's agrarian economy supports 55 percent of rural households but faces significant challenges, including diminishing land holdings, limited economies of scale, restricted access to information, and obstacles in price discovery. This disorganization prevents farmers from securing fair market prices, leading to debt cycles driven by low prices and market volatility. In this context, organizing into Farmer Producer Organizations (FPOs) could empower farmers and improve their market position. This study investigates the participation and attitudes of member farmers towards FPOs in South Gujarat. Its objectives include analysing the socio-economic profiles of these farmers, assessing their attitudes towards FPO services, and identifying perceived constraints in FPO functioning. The descriptive research design was used and data were collected from 350 member farmers across seven selected FPOs through a structured questionnaire, with appropriate statistical tools employed for analysis. The findings revealed that a significant majority of farmers were middle-aged, with majority small farmers and marginal farmers. Farmers showed a positive attitude towards FPOs, valuing the enhancement of socio-economic status and livelihood security as key benefits. However, several constraints impact FPO effectiveness, including social issues such as lack of conflict management and trust, economic challenges like non-availability of timely credit, technical limitations such as



inadequate storage, and managerial concerns related to high competition and insufficient business skills. To address these issues, the study recommends implementing capacity-building training, diversifying FPO services, fostering market linkages, establishing transparent financial management, and promoting awareness about FPOs. Overall, this study highlights the essential role of FPOs in enhancing the socio-economic conditions of farmers while identifying key areas for improvement.

IMPACT OF BIOSTIMULANTS ON OIL YIELD AND COMPOSITION OF SACRED BASIL (*OCIMUM SANCTUM* L.)

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Abstract

The present investigation entitled “Impact of biostimulants on oil yield and composition of sacred basil (*Ocimum sanctum* L.)” was carried out during 2021-22 & 2022-23 at College of Horticulture, Sri Konda Laxman Telangana State Horticultural University, Rajendranagar, Hyderabad. The experiment was laid out in a Factorial Randomized Block Design (FRBD) with 14 treatments, replicated thrice. The treatments include two varieties (V_1 and V_2) and seven biostimulants (B_1 , B_2 , B_3 , B_4 , B_5 , B_6 and B_7). The results conferred that among the treatments, maximum oil yield per plant (g/plant) (1.59, 1.65 and 1.62), Oil yield per plot (g/plot) (59.78, 62.05 and 60.91), Oil yield per hectare (Kg/ha) (99.63, 103.42 and 101.52), Quality parameters viz., Eugenol content (38.65, 40.82 and 39.74), Methyl eugenol (24.17, 25.13 and 24.65), Caryophyllene (11.63, 12.10 and 11.87) and Chlorophyll content (46.64, 50.80 and 48.72) were recorded in T_6 - CIM- Ayu and Seaweed extract @ 10% (V_1B_6). Whereas the maximum content of Limonene (1.77, 1.82 and 1.79), Linalool (1.49, 1.54 and 1.51), Methyl chavicol (1.40, 1.45 and 1.42) and Beta elemene (14.19, 14.65 and 14.42) were recorded in T_{13} - CIM- Angana and Seaweed extract @ 10% (V_2B_6) during the years 2021, 2022 and pooled respectively.

SMART WEEDING: LEVERAGING ROBOTICS AND AI FOR PRECISION AGRICULTURE

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Abstract

The integration of robotics and artificial intelligence (AI) in weed management represents a transformative approach in modern agriculture, offering precise, efficient, and sustainable solutions to one of the industry's most challenging problems. Traditional weed control methods, such as chemical herbicides, have raised concerns regarding environmental pollution, biodiversity loss, and health risks. In contrast, robotics and AI technologies enable the development of automated systems capable of accurately identifying, targeting, and removing weeds with minimal human intervention. These systems utilize advanced machine learning algorithms, computer vision, and sensor technologies to differentiate between crops and weeds, ensuring targeted application of control measures. Robotics enhances precision by allowing for site-specific management, reducing herbicide usage, and minimizing damage to non-target plants. AI-driven weed management systems can operate autonomously, optimizing operations for various types of crops and environments, thus promoting efficiency and reducing labor costs. Robotics systems, such as robotic weeders and autonomous tractors, are equipped with mechanical tools or precision spraying mechanisms that perform weeding tasks with high accuracy, even in large-scale farming operations. Additionally, these systems are capable of continuous learning, adapting to new weed species and evolving environmental conditions, thus ensuring long-term effectiveness. Furthermore, smart-weeding by robotics and AI applications contributes to sustainability by reducing the reliance on chemical inputs, enhancing biodiversity, and lowering the carbon footprint.



associated with farming practices. While challenges such as cost, scalability, and technical limitations remain, the potential benefits of these technologies in improving weed control while preserving ecosystem health are immense. As AI and robotics continue to evolve, they are poised to become indispensable tools in creating a more sustainable and productive agricultural landscape, offering solutions to the growing challenges of global food production and environmental stewardship.

EFFECT OF UV LIGHT ON BIOLOGY OF PULSE BEETLE *CALLOSOBRUCHUS CHINESIS* L.

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Abstracts

Pulses are one of the important groups of worldwide crops and play major role in daily diet. It is a richest source of protein play an important role in the diet of rural and urban masses. Pulses provide a balanced diet for millions of people, provided it is eaten in proper combination with cereals. It is good substitute of meat, fish, and egg. Total production of pulses in India was 13.18MT, which is increased by 27.30 million MT during 2021-22. In Maharashtra, chickpea is grown in an area of 19.27 lakh ton. During 2020-21, chickpea had a lion's share of 49.3% in the total pulses production (Mudryj. *et.al.* 2014). Worldwide, it is estimated to be 10-40% of stored products were lost due to insects, fungus, bacteria and viruses. India produces around 12.65 million tons of pulses per year and nearly 8.5% of this is lost during post harvested handling and storage.

The experiment on Management of Pulse beetle through UV light under different exposure and height was conducted at AICRP on PHET of Dr P.D.K.V Akola during 2023-24 on Completely Randomized design with the objectives To assess the effect of exposure times and distance of UV-light on developmental stages of pulse beetle, *Callosobruchus chinensis* L. The experiment had two distance and three exposure period of UV light. The UV light of 254 nm wavelength 2.5ft length and 15 wt were used for exposure. The mass culture of pulse beetle on chickpea grain were used for the study. Initially 20 pair of pulse beetle were released on 250 g of chickpea grain and collected the 50 eggs on grain and kept under UV light for 10, 20 and 30 min exposure and study the biology of the pulse beetle. The study showed that at 10 cm height and 30 min exposure period gave the statistically significant result was found in recording the minimum hatching percent, increased larval, pupal and total life cycle period. Accordingly, increasing incubation period and maximum adult mortality, minimum adult longevity, were noticed.

PLANTS EQUIP SEEDS WITH SIMILAR BACTERIAL ENDOPHYTIC COMMUNITIES OF *SETARIA VIRIDIS* L. IRRESPECTIVE OF SOIL MICROBIAL COMMUNITIES

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Abstract

Plant-associated microorganisms are vital for nutrient uptake, disease suppression, and stress resistance. Thus, a better understanding of plant-bacteria interaction paves a path for improving plant resistance and resilience to extreme weather events and mitigating yield decline. Also, the role of the soil microbial community in the assembly of the seed microbiome is poorly understood. In addition, whether the community assembly in seed microbiome is governed by stochastic or deterministic processes is poorly known. We hypothesized that plants would equip seeds with similar taxonomic and functional microbial diversity despite being grown in soils with varying microbial diversities to meet offspring's physiological needs, as well as the deterministic effect of the host plant. To support this hypothesis, a model plant, *Setaria viridis*, was grown in soils with contrasting microbial richness (Negev and PotMix). Furthermore, soil microbial community composition was assessed using 16S amplicon sequencing. *S. viridis* grown in pot-mix soil were significantly taller and developed higher root biomass than plants grown in Negev soil. From 16S data, a significant difference in alpha diversity was observed for bulk soils; however, these differences were not observed in the plant compartment. The seed endophytes from both soil types had a very similar community composition and an equally high species diversity. A significant portion of seed endophytes comprises of putative diazotrophs. The results show that plants equipped seeds with almost similar endophytic communities regardless of soil bacterial composition. In addition, the taxonomic seed endophytic community was governed by deterministic processes.



ALLELOPATHIC EFFECT OF *EUCALYPTUS TERITICORNIS* SM. ON GERMINATION AND PERFORMANCE OF BLACKGRAM(*VIGNA MUNGO*) AND NIGER (*GUIZOTIA ABYSSINICA*)

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Abstract

The present investigation entitled “Allelopathic effect of *Eucalyptus teriticornis* Sm. on germination and performance of Blackgram(*Vigna mungo*) and Niger (*Guizotia abyssinica*)” was laid out in complete randomized design with 5 treatments and 4 replication in the laboratory and nursery of College of Forestry, Odisha University of Agriculture and Technology, Bhubaneswar during the year 2021-2023. The allelopathic effect of *Eucalyptus teriticornis* leaf litter in the concentration 0,25%,50%,75%,100% were studied on two crops blackgram (*Vigna mungo*) and niger (*Guizotia abyssinica*) respectively. The experiment was carried out in polypot in open field. Litter treatments in polypots were determined by considering the annual average leaf litter fall of *Eucalyptus* for three months. T1 (control) for germination percentage, germination energy, germination rate index, peak value, mean daily germination, germination value, radicle length, plumule length, radicle to plumule ratio and seed vigour index were found to be maximum in T1 (control-without any addition of leaf litter). The above parameters gradually reduced with increase in concentration to minimum in T5 (100%). The seed vigour index in T5 (100%) was 228.45 and 180.25 in blackgram and Niger respectively showed blackgram has the better ability to perform against allelopathic effect over niger.

OPTIMIZING NITROGEN FOR PRODUCTIVITY, PROFITABILITY AND OIL YIELD ENHANCEMENT THROUGH GREENSEEKER, AMPLIFIED NUTRIENT USE INDICES IN MUSTARD CULTIVATION

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Abstract

A field experiment was conducted during *rabi* season of 2023-24 to assess real time nitrogen management in mustard over blanket recommendation. The study was comprised of ten N management modules including unfertilized treatment under randomized complete block design in three replicates. Data indicated that GreenSeeker (GS) based N application significantly augmented seed yield by 24.6 and 72.6%, NMR 38.9 & 126.77%, BC ratio 41.2 & 112.8%, and oil yield by 28.8 and 84.3%, respectively over RDF and control with per cent N saving of 18.7%. Moreover, sensor guided N administration acquired higher CPE (21.0 kg/day) with lesser production cost (Rs 1508/q) and reduced required N amount by 15- 20%. The crop nutrient acquisition and various nitrogen efficiency indices were significantly affected for their use efficiencies and effectiveness. The greater values of AE_N (19.2), PFP_N (45.6) and NRE (57.4%) were recorded under GS based N application along with higher total NPK recovery (99.3, 55.1 & 178.2 kg ha⁻¹). The values of MEI, NHI, IUE, PNB, PEN and AEP & AEK were lies in between 2.06-2.43, 1.54-1.64, 29.83-33.10, 0.95-1.53 kg/kg, 26.1-28.3% and 16.5-31.2, respectively among the treatments. Further, N foliar spray treatments at N₁₀₀ level registered for per cent negative changes in N (-1.46 to -6.90%) over RDF. However, maximum per cent N saving was recorded under NFS @ 1.5% KNO₃ due to partial N application at N₇₅ (61.17 kg N/ha) over RDF.

EFFECT OF DRYING METHODS ON NUTRITIONAL QUALITY OF DEHYDRATED BITTER GOURD

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Abstract

Bitter gourd is very low in calories but dense with precious nutrients. It is an excellent source of vitamins B complex, vitamin C, proteins, magnesium, folic acid, iron, zinc, phosphorus, manganese, and has high dietary fiber and many other nutrients



required in the human diet which are necessary for maintaining proper health. It is reported to be a good source of phenolic compounds, which possess potent antioxidant activity. It has an action similar to insulin, thus helping in glucose metabolism. It purifies blood, activates spleen and liver and is highly beneficial in diabetes. Dried product is preferred because of advantages like reduced mass and lowers packaging requirements. They are also used in cooked, stuffed and fried forms. Because of its restricted availability only in harvesting season, perishable nature and development of rubbery texture, loss of bitterness and development of brown colour after dehydration. The present investigation was conducted to develop dehydrated product from bitter gourd. Dehydrated Bitter gourd were prepared using two drying methods i.e. sun drying and tray drying. Pre-treatments like steam blanching and hot water blanching, and preservative such as KMS were used. Dried bitter gourd was stored in HDPE film packets for shelf life studies at ambient condition. Tray drying of bitter gourd was observed better as compared to the sun drying. Whereas, maximum retention of total phenolic content, Chlorophyll content and carotenoid content was found in pre-treatment of bitter gourd with hot water blanching for 96°C for 3 min and dip in KMS solution (0.2%) for 5 min but vitamin C content was found maximum in steam blanching for 3 min and dip in KMS solution (0.5%) for 5 min.

INFLUENCE OF ORGANIC INPUTS ON YIELD, NUTRIENT UPTAKE AND SOIL PROPERTIES OF SOYBEAN

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Abstract

A field experiment was conducted at the Research Farm of the Department of Soil Science and Agril. Chemistry, College of Agriculture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, during the Kharif season of 2022. The study aimed to evaluate the effects of different organic inputs on soybean yield, soil nutrient availability, and nutrient uptake. The experiment utilized a factorial randomized block design with twelve treatments and three replications. The experimental treatments involved two factors: the first factor included three levels of chemical fertilizers and organic manures (F1: Recommended Dose of Fertilizers (RDF), F2: Farm Yard Manure equivalent to RDN, F3: Vermicompost equivalent to RDN). The second factor consisted of four levels of organic formulations (OF0: Control, OF1: Panchagavya, OF2: Beejamruth + Jeevamruth, OF3: Beejamruth + Jeevamruth + Panchagavya). Significantly higher grain yield and dry matter yield of soybean were observed with the treatment receiving 100% RDF + Beejamruth + Jeevamruth + Panchagavya. This treatment also resulted in the highest uptake of nitrogen, phosphorus, potassium, and micronutrients by soybean plants. Electrical conductivity (EC), organic carbon, and calcium carbonate content after soybean harvest showed non-significant differences among treatments. However, the treatment with 100% RDF + Beejamruth + Jeevamruth + Panchagavya recorded significantly higher values of available nitrogen and potassium oxide (K₂O). DTPA-extractable zinc, iron, manganese, and copper were also highest in the treatment with 100% RDF + Beejamruth + Jeevamruth + Panchagavya.

BOOSTING AGRARIAN EFFICIENCY AND NUTRITIONAL VALUE OF MILLETS VIA BIO-FORTIFIED HYBRIDS IN INDIA

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Abstract

India's agricultural landscape is evolving to address the dual challenge to increase crop productivity and improve nutritional security. Millets are pivotal in addressing food and nutritional security as they possess rich nutrient profiles and resilience to arid conditions. However, their limited productivity and low adoption rates among Indian farmers necessitate innovative approaches to achieve the United Nations Sustainable Development Goals. This review aims to explore the potential of latest



bio-fortified millets hybrid varieties as a solution to bolster agrarian efficiency and nutritional security. Bio-fortified millet-hybrid-varieties (pearl millet – ICMH 1202, ICMH 1203 and ICMH 1301; finger millet – VL Mandua 402; pearl millet – MH 2417) cultivated across diverse Indian agro-climatic-zones by following appropriate scientific-management-practices such as correct soil selection, seed rate, plant population, sowing time and sowing methods, seed treatment, fertilizer management etc. demonstrated higher productivity and resilience to climate variability compared to traditional millet varieties. Additionally, nutritional analysis reveals significant enhancements in micronutrient and macronutrient content in various biofortified millet varieties such as iron-and-zinc-enriched pearl-millet-varieties - Dhanashakti and HHB 299, high-calcium finger-millet-varieties - KMR 204 and PR 202, protein-enriched sorghum varieties like Parbhani Shakti, vitamin-enriched foxtail-millet-varieties such as SiA 3156, zinc-enriched little millet contribute positioning these hybrids as a viable strategy to combat malnutrition, particularly in rural and tribal communities. This review focus on the socio-economic impact of promoting bio-fortified millet varieties, emphasizing their role in diversifying farmer incomes and revitalizing underutilized croplands. The adoption of bio-fortified millet hybrid varieties can be scaled by partnering with various research institutions, government and non-government bodies, and agricultural cooperatives. To conclude, the development and dissemination of bio-fortified millet hybrids serves as an innovative approach to not only strengthens the country's agrarian economy but also contributes to global efforts in addressing hunger and malnutrition through sustainable, climate-resilient food systems in both urban and rural areas.

EVALUATION OF COMBINING ABILITY, AND HETEROSIS FOR PLANT GROWTH, FRUIT QUALITY, YIELD AND ITS CONTRIBUTING CHARACTERS IN MUSKMELON (*CUCUMIS MELO* L.)

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Abstract

Seven genetically diverse cultivar, including two inbreed lines, of muskmelon (*Cucumis melo* L.) were crossed in a half-diallel to generate 21 F₁ hybrids. These hybrids, along with the parental lines and commercial check, were evaluated in RBD design during summer-2024 at research farm, College of Agriculture, Swami Keshwanand Rajasthan Agriculture University, Bikaner for their growth, fruit quality, yield and its contributing characters. Mean performance of parents revealed that there was good range of variability for various characters among the parents used for crossing. The general combining ability was studied that, the parents Thar Mahima, AHMM/BR-8, Punjab Sunehri, Hara Madhu and Durgapura Madhu were the best general combiners to the yield and yield contributing characters. The dominance variance was greater than additive variance for all the characters except for some yield contributing traits. The specific combining ability was studied and the cross AHMM/BR-8 × Punjab Sunehri, Thar Mahima × Durgapura Madhu, Thar Mahima × Hara Madhu and Durgapura Madhu × Hara Madhu was found best specific combiner to the yield and yield contributing characters. The cross AHMM/BR-8 × Punjab Sunehri, Punjab Sunehri × Hara Madhu, AHMM/BR-1 × Thar Mahima, Thar Mahima × Durgapura Madhu, Durgapura Madhu × Hara Madhu and Thar Mahima × Hara Madhu was recorded to the significant positive heterosis for most of the yield contributing characters.

POTENTIALITY OF MUNGBEANS ASUMMERLEGUMECROPFOR PRODUCTIVITY ENHANCEMENT UNDER EASTERN ZONE OF HARYANA

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Abstract

The continuous practice of the rice–wheat cropping system has led to soil quality depletion and fertility degradation, resulting in a decline in crop productivity. Introducing mungbean as a summer crop during the fallow period (April–June) holds great potential for providing additional income while improving soil health. Cluster Frontline Demonstrations (CFLDs) were

conducted to showcase the production potential of improved mungbean cultivation practices. These demonstrations were implemented by Krishi Vigyan Kendra across 44.39 ha in 110 farmers' fields in the Karnal district of Haryana over two consecutive summer seasons (2021 and 2022). Critical inputs for improved production technology were identified through Participatory Rural Appraisal (PRA) in the adopted villages. Traditional farming practices were used as a control for comparison with the recommended practices. Results indicated that the average yield of mungbean under improved practices ranged from 8.5 to 10.2 q/ha, compared to 5.2 to 6.8 q/ha under traditional practices. The maximum seed yield (12.3 q/ha) was recorded in 2021, which was 80.88% higher than the farmers' practice (6.8 q/ha). On average, the improved practices resulted in a 50% yield increase compared to traditional methods. This yield gap can be attributed to differences in crop management practices, soil fertility, and agro-climatic conditions in the Karnal district. The average net profit under improved practices was ₹44,000/ha, compared to ₹18,300/ha under traditional practices. The benefit-cost ratio was also significantly higher under improved practices (3.00) compared to traditional methods (1.92).

BIOCHEMICAL ALTERNATION IN COWPEA DUE TO INOCULATION OF *PSEUDOMONAS FLUORESCENS* AND *MELOIDOGYNE INCOGNITA*

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Abstract

Root-knot nematode, *Meloidogyne incognita* is widely distributed in the pulse growing areas causing extensive loss in grain yield with several physiological and biochemical changes in cowpea in India. A pot culture experiment was carried out in the net house in the Department of Nematology, OUAT, Bhubaneswar, Odisha during kharif, 2023 to evaluate the biochemical changes induced by *Pseudomonas fluorescens* and *M. incognita* in cowpea cv Kashi Nidhi. The experiment comprises of six treatments (T1: Soil application of *P. fluorescens* @ 2.5mg/kg of soil during sowing, T2: Inoculation of *M. incognita* @ 1000J2/kg of soil at 15 DAS as inoculated check, T3: Application of *P. fluorescens* at 15 days after inoculation of *M. incognita*, T4: Inoculation of *M. incognita* at 15days after the soil application of *P. fluorescens*, T5: Simultaneous application of *P. fluorescens* and *M. incognita* at 15 DAS, T6: Untreated un-inoculated check) which were replicated four times following CRD. The findings revealed that all treatments had higher levels of biochemical components as compared to the inoculated check. Both *P. fluorescens* and *M. incognita* alter the biochemical parameters in cowpea plants. Soil application of *P. fluorescens* at 2.5 mg/kg during sowing showed the highest content in chlorophyll-a (0.80 mg/g), chlorophyll-b (0.48 mg/g), total chlorophyll (1.32 mg/g), carotenoid (0.59 mg/g), carbohydrate (82.66 mg/g), protein (44.11 mg/g) and proline (88.96 mg/g) among the all treatments. Among the *M. incognita* inoculated plants, the treatment T4 gave better result with notable values in chlorophyll-a (0.69 mg/g), chlorophyll-b (0.38 mg/g), total chlorophyll (1.17 mg/g), carotenoid (0.48 mg/g), carbohydrate (60.24 mg/g), protein (42.48 mg/g) and proline (100.33 mg/g) than other root knot inoculated plant. The lowest increase in biochemical parameters over the inoculated control was observed in T3. There for soil application of *P. fluorescens* during sowing of cowpea offer a promising environmental friendly approach to mitigate the damage cause by root-knot nematode *M. incognita*.

ENHANCING GREEN FODDER AND SEED YIELD OF BERSEEM THROUGH HERBICIDAL WEED MANAGEMENT

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Abstract

A field experiment was conducted during the Rabi season of 2022-23 at central research farm of ICAR-Indian Grassland and Fodder Research Institute, Jhansi to find out the best weed management technique in berseem (*Trifolium alexandrinum* L.) for green fodder and seed production. The experiment was scheduled in randomized block design with three replications having nine treatments, viz. weedy check, weed free check, mechanical stale seed bed, pendimethalin + imazethapyr @ 0.75 kg a.i./ha, metribuzin @ 0.4 kg a.i./ha, glyphosate @ 1.0 kg a.i./ha fb imazethapyr + imazamox @ 0.07 kg a.i./ha, glyphosate @ 1.0 kg a.i./ha fb bentazone @ 1.3 kg a.i./ha, paraquat @ 0.5 kg a.i./ha fb imazethapyr + imazamox @ 0.07 kg a.i./ha and paraquat @ 0.5 kg a.i./ha fb bentazone @ 1.3 kg a.i./ha.



Application of glyphosate @ 1.0 kg a.i./ha fb imazethapyr + imazamox @ 0.07 kg a.i./ha recorded the lowest weed density (4.42/m²) and dry weight (2.60 g/m²) compared to other treatments. The significantly highest green fodder (291.38 q/ha) and seed yield (5.44 q/ha) were recorded in weed free check treatment. However, among the herbicide applied treatments, application of glyphosate @ 1.0 kg a.i./ha fb imazethapyr + imazamox @ 0.07 kg a.i./ha recorded the significantly highest green fodder (277.61 q/ha) and seed yield (5.10 q/ha). The weed free check treatment also recorded the highest gross returns (1,42,397 ₹/ha) and cost of cultivation (72,751 ₹/ha) followed by application of glyphosate @ 1.0 kg a.i./ha fb imazethapyr + imazamox @ 0.07 kg a.i./ha recorded the highest gross returns (1,31,472 ₹/ha) and cost of cultivation (57,702 ₹/ha). Amid all the herbicide treatments the highest net returns (73,770 ₹/ha) as well as benefit cost ratio (2.28) were recorded under glyphosate @ 1.0 kg a.i./ha fb imazethapyr + imazamox @ 0.07 kg a.i./ha application.

ADVANCED APPROACHES USED IN CROP IMPROVEMENT PROGRAMME IN WATERMELON

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Abstract

Watermelon (*Citrullus lanatus* L.) is an economically and nutritionally important fruit crop, with growing consumer demand for traits like enhanced sweetness, seedlessness, nutritional content and resilience to climate stress. Traditional breeding methods have long been used to improve watermelon varieties, but the recent integration of advanced breeding approaches has accelerated the development of superior cultivars. Techniques such as CRISPR gene editing, marker-assisted selection (MAS) and genomic sequencing enable more targeted and efficient improvements, allowing breeders to focus on traits like disease resistance, drought tolerance and flavor enhancement with greater precision. CRISPR, a precise gene-editing tool, has opened new possibilities for altering specific genes responsible for desirable traits without introducing foreign DNA, potentially easing regulatory processes. Meanwhile, MAS and genome-wide association studies (GWAS) have greatly aided the identification of genetic markers linked to key traits, expediting the selection process and reducing breeding cycles. Furthermore, polyploidy and hybridization techniques have enabled the development of seedless watermelons through triploid hybrids, a popular innovation that has expanded market appeal. Despite these advances, challenges remain. The high cost and technical requirements of these technologies may limit access for breeders in resource-limited settings and the regulatory environment for gene-edited crops is complex and varies widely by country. Consumer perception also poses a challenge, as gene-edited and genetically modified crops can face market resistance. In addition, there is a critical need to preserve genetic diversity within watermelon germplasm to safeguard against disease susceptibility and changing environmental conditions.

ADVANCES OF SOILLESS CULTURE APPROACHES FOR GROWING VEGETABLE CROPS

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Abstract

Soil based cultivation is now facing difficulties due to different man-made reasons such as industrialization and urbanization. Also, sudden natural disasters, climate change and unrestricted utilization of chemicals for agriculture purposes cause the depletion of soil fertility and quality. That is why, scientists have developed a new alternative approach for cultivation system namely soil-less cultivation or hydroponics. Hydroponics can be briefly defined as cultivation of plants without soil. In short, hydroponics, a Greek word meaning “hydro” (water) and “ponos” (labour) is the method of growing plants in different types of substrates (chemically inert), sand, gravel, or liquid (water), in which nutrients are added, but no soil is used or hydroponics is a technique of growing plants in soil-less condition with their roots immersed in nutrient solution. The word hydroponics was coined by Professor William Gericke in the early 1930s describe the growing of plants with their roots suspended in water containing mineral nutrients. It is practically feasible to grow any kinds of vegetables, fruits, fodder or crops using this technique. Flowers give a better bloom and colour when grown hydroponically. Hydroponics system might be automated, that is why it is well controlled and better for end product collection. Several plants including vegetables, fruits, flowers, medicinal



crops can be grown using soil-less or hydroponics culture. Main types of hydroponic, according to growers, farmers and researchers, Deepwater culture (DWC), NFT, Ebb and Flow system, Drip system, Substrate Culture, Airoponics etc. Hydroponics technique presents a “new” door of science helping more crop production for food, fodder and ornamental use as well as produce improved yield quality. Hydroponics can produce high yield of local crops, such as leafy vegetables or flowers in the over-populated areas. If it is possible to modernize the hydroponics technique, all plants and crops can be cultivated through all over the world.

MASS PRODUCTION OF NATIVE ISOLATE OF ENTOMOPATHOGENIC NEMATODE, *STEINERNEMA* SP. (AAU ST-1)

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Abstract

The *in vivo* mass production of the native entomopathogenic nematode, *Steinernema* sp. (AAU St-1), utilizing *Corcyra cephalonica* larvae as a host. The study inoculated various stages of larvae, from second to fifth instars, with infective juveniles (IJs) of *Steinernema* sp. (AAU St-1). The results showed that the fifth instar larvae yielded the highest number of IJs, followed by the fourth and third instar larvae. The maximum average yield of 90307 IJs/larva of *Steinernema* sp. (AAU St-1) was recorded from the fifth instar, followed by 78674 and 47771 IJs per larva from the fourth, third instar, respectively. The study concludes that *C. cephalonica* serves as an effective and efficient host for the large-scale production of *Steinernema* sp. (AAU St-1) and highlights the potential of this nematode species for biocontrol applications. The findings support the use of *Steinernema* sp. (AAU St-1) as an environmentally friendly alternative for pest management in agriculture, offering an optimized approach for the commercial-scale production of EPNs. The research contributes to improving the sustainability and efficiency of biological control practices through EPNs.

SCREENING OF DIFFERENT LINES OF CHICKPEA RESISTANT AGAINST WILT

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Abstract

Chickpea (*Cicer arietinum* L.) is an important legume crop widely cultivated for its high nutritional value and economic significance. However, the productivity of chickpea is severely impacted by Fusarium wilt (*Fusarium oxysporum* f. sp. *ciceris*), a soil-borne fungal disease that causes significant yield losses worldwide. The development of wilt-resistant chickpea cultivars is crucial for sustainable production. This study aims to screen and evaluate different chickpea lines for resistance to Fusarium wilt under field conditions. A total of 148 chickpea genotypes with potential resistance to wilt, were assessed for their reaction to *F. oxysporum* infection. Resistance was evaluated based on disease incidence, disease severity. The genotype ICCx171017-BBBB/NBEG-47 JG-24 exhibited the lowest area under disease progress curve value at 0.00, indicating a notable resistance to the disease. However, it displayed a significantly lower susceptibility to the disease when compared to the remaining genotypes. The 57 genotypes were showed resistant reaction, 63 genotypes were showed moderately resistant reaction, 8 genotypes were showed moderately susceptible reaction, 11 genotypes were showed susceptible reaction, and 8 genotypes were showed highly susceptible reaction. The most resistant lines demonstrated minimal wilt symptoms, lower disease severity, and better overall plant vigor. These lines were further analyzed for potential genetic markers associated with resistance. The findings provide valuable insights into identifying chickpea lines with durable resistance to Fusarium wilt,



which can be used in breeding programs for developing resilient chickpea cultivars. This research highlights the importance of incorporating disease resistance into chickpea breeding to enhance productivity and ensure food security in affected regions.

INVESTIGATING FINANCIAL LITERACY AMONG OWNERS OF MICRO, SMALL AND MEDIUM ENTERPRISES

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Abstract

The present study carried out on “Investigating Financial Literacy among Owners of Micro, Small and Medium Enterprises”. A purposive sampling method used for the selection of three districts for the study. Primary data collected from the sample of 320 owners of micro, small and medium enterprises using a pre-structured schedule survey method. The secondary data collected from various publications and government departments. The aim of the study was to examine the level of financial literacy of owners, analyse the factors that influence the level of financial literacy in terms of socio-economic variables and the impact of financial literacy on the financial performance of selected units. The analysis of variance and multi-nominal regression model implemented on the primary data to obtain the relationship between the financial literacy of MSME's in terms of socio-economic variables and to obtain the level of impact that financial literacy had on the financial performance of the of sampled MSME's. The finding of the study suggests that owners of MSME's have moderate financial literacy level and gender, age, education status of the owners had significant effects on the financial literacy. It was observed that owner's financial literacy level in a micro, small and medium enterprises can be the key factor for enterprises business financial performance boost and other financial aspects and socio-economic factors plays an important role in determining the financial literacy of the individual owners of MSME's.

GROWTH PARAMETERS AND YIELDS ASSESSMENT OF DIFFERENT BAJRA NAPIER HYBRIDS IN THE TRANSITIONAL PLAIN OF LUNI BASIN

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Abstract

A field experiment was conducted at Agricultural Research Station, Keshwana, Jalore under arid climate conditions during 2019 and 2020 to growth, yield attributes and yields of four varieties of Bajra Napier Hybrids. The data indicated that the variety Co-4 recorded maximum growth attributes like plant height, plant shoots, CGR at different intervals and yields during both years. Variety Co-4 also produced the maximum gross (Rs132405) and B: C ratio (2.66).

ADVANCES IN INTEGRATED PEST MANAGEMENT: CHALLENGES AND PERSPECTIVES

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Abstract

There are many constraints that severely affect the global agricultural production and productivity which include the ever increasing of population growth, degradation of natural resources, climate changes and emerging pests. Among these factors, biotic constraints or pests are known to cause 25-50% or complete loss of plant production. IPM represents a comprehensive and sustainable approach to pest management that aims to minimize the economic, environmental, and health risks associated with pest control practices. IPM integrates a variety of tactics, including cultural, biological, physical, chemical, and behavioural controls, to manage pest populations effectively while reducing reliance on chemical pesticides. Key components



of IPM include regular monitoring, setting action thresholds, implementing preventive measures, and integrating multiple control tactics in a coordinated manner. Development of novel biological control agents, including genetically engineered organisms and microbiome-based formulations, represents a paradigm shift towards sustainable and environmentally friendly pest management solutions. Furthermore, the integration of data analytics, machine learning, and artificial intelligence (AI) into IPM decision-making processes empowers growers to optimize pest management strategies, predict pest outbreaks, and minimize environmental impact.

THE ROLE OF BIOLOGICAL CONTROL IN THE CONTEXT OF BIODIVERSITY ENHANCEMENT OF AGROECOSYSTEMS

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Abstract

Biological control plays a vital role in enhancing biodiversity within agroecosystems by promoting natural ecological balance and reducing reliance on synthetic inputs. Biological control significantly contributes to biodiversity enhancement by encouraging the proliferation of beneficial organisms, which creates a more complex and balanced food web, increasing species diversity within the ecosystem. In agroecosystems excess use of chemical pesticides harms non-target species; biological control reduces the utilization of chemical pesticides, which fosters the survival and reproduction of a wide range of organisms and also helps to protect rare or native species that might otherwise be at risk from pesticide use. Habitat diversification, which provides habitats for natural enemies, also increases overall ecological stability. Further, functional biodiversity ensures that multiple species contribute to pest suppression, making the system less reliant to pest outbreaks and environmental stresses. Biological control integrates well with other ecosystem services, and these services create a synergistic effect on the overall health of the agroecosystems. However, biological control offers significant benefits and requires careful management to avoid unintended consequences, such as the introduction of invasive biological control agents that might disrupt local ecosystems. Additionally, fostering a biodiversity-friendly agro-ecosystem may require initial investments and ongoing ecological monitoring. Interestingly, biological control is a cornerstone of sustainable agriculture, fostering biodiversity, reducing environmental impact, and promoting ecosystem resilience in agroecosystems.

FUSARIUM WILT : MAJOR PROBLEM IN CASTOR GROWING AREAS

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Abstract

Castor (*Ricinus communis* L.) is one of the most important non-edible oilseed crop in the world. It can grow in warm and low moisture environment. It is more suitable for western Rajasthan. Castor seed containing 45-50 per cent oil and its cakes contains nitrogen 4.5 %, P₂O₅ 1.75 % and K₂O 1.5 %. India has 10.05 lakh ha area and 20.54 lakh tones production with an average productivity of 2040 kg/h. In India, it is predominantly grown in the states of Gujarat, Rajasthan, Andhra Pradesh, Tamil Nadu, Orissa Maharashtra, Karnataka etc. These States together shared more than 90 per cent of total production. Castor crop is attacked by several insect pests and diseases and these biotic stresses depredate the castor crop productivity and quality posing a threat to its commercial cultivation. In India, wilt disease is mainly found in Rajasthan, Gujarat, Tamil Nadu and other castor growing areas and causes great harm to castor crop. Wilt is an important devastating disease in dry lands and caused losses 10 to 40 % in yield, 8-14% in seed weight and 1 to 2% in oil content (Lakshminarayana and Raoof, 2006). Castor wilt caused by *Fusarium oxysporum* f.sp. *ricini* is the most common and major disease in several castor growing areas of the country. The disease was first reported in 1937 from Brazil and in India from Udaipur, Rajasthan in 1974 (Nanda and Prasad, 1974). The disease occurs at all stages of the crop growth, starting from seedling to maturity, resulting in loss of plant population. They described the symptoms as yellowing, sickly appearance and marginal necrosis which later advances



interveinal and covers the leaves completely. Leaves shrivels lower ones drop away leaving only few top leaves followed by irreversible wilting of the plant adding to sudden death. Transverse and longitudinal sections of the affected roots revealed the presence of fungus in vascular tissues and in xylem parenchyma. Tylose formation also observed in xylem vessels of infected roots. The infected stem tissues showed intracellular mycelium in vessels and hypertrophy of xylem parenchymatous cells.

INTRODUCTION TO GWAS AND ITS IMPORTANCE IN PULSE CROP IMPROVEMENT

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Abstract

Pulses are essential food crops due to their high protein content (20-25%), mineral content (iron, magnesium, potassium, phosphorus, zinc), omega-3 fatty acids, and vitamins (Langyan et al., 2022). Pulses are nutritionally dense and adapt well to their environment, promoting dietary diversity and reducing malnutrition and hidden hunger (Ritchie et al., 2018). GWAS is a statistical approach in genetics that identifies genetic variants (SNPs) linked to specific traits in a diverse population. These markers are genotyped in a diverse panel of pulse crop accessions or breeding lines. Statistical methods are then used to assess the association between genetic markers and trait variations. Various types of GWAS models are used to associate genotype with phenotype like GLM, MLM, FARMCPU, etc. GWAS results can guide the pyramiding of multiple beneficial haplotypes into a single crop variety. GWAS in pulses will continue to be a valuable tool for advancing crop improvement, enhancing resilience to environmental challenges, and addressing nutritional needs. GWAS play a vital role in accelerating the development of improved pulse varieties with traits like higher yields, disease resistance, and nutritional quality. Advances in genomics and high-throughput sequencing technologies will enable more precise and targeted breeding strategies.

FOOD PROCESSING AND VALUE ADDITION

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Abstract

Some functional foods contain biologically active compounds (BAC) that can be derived from various biological sources (fruits, vegetables, medicinal plants, wastes, and by-products). Global food markets demand foods from plant materials that are “safe”, “fresh”, “natural”, and with “nutritional value” while processed in sustainable ways. Functional foods commonly incorporate some plant extract(s) rich with BACs produced by conventional extraction. This approach implies negative thermal influences on extraction yield and quality with a large expenditure of organic solvents and energy. On the other hand, sustainable extractions, such as microwave-assisted extraction (MAE), ultrasound-assisted extraction (UAE), high-pressure assisted extraction (HPAE), high voltage electric discharges assisted extraction (HVED), pulsed electric fields assisted extraction (PEF), supercritical fluids extraction (SFE), and others are aligned with the “green” concepts and able to provide raw materials on industrial scale with optimal expenditure of energy and chemicals. This review provides an overview of relevant innovative food processing and extraction technologies applied to various plant matrices as raw materials for functional foods production.

CURRENT STATUS OF AGROFORESTRY IN INDIA

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Abstract

Agroforestry is currently practiced on about 28.42 million hectares of land in India, which is around 8.65% of the country's total geographical area. This indicates that farmers are increasingly adopting agroforestry practices. Launched in 2016-17, this



mission aims to promote tree plantation on farmlands to help farmers earn additional income and make their farming systems more climate resilient. These systems include trees on farms, as well as local forest management and agroforestry practices. Agroforestry can provide social, economic, and environmental benefits for land users. It can diversify and sustain production, and can also help with degraded land rehabilitation. An estimated 65% of India's timber and almost half of its fuel wood come from trees grown on farms. These states cover 12.41% of India's agroforestry area, and are a vital source of commodities like timber, fruits, fuelwood, fodder, and fiber.

REACTION OF PEA VARIETIES/GENOTYPES AGAINST ROOT ROT (*RHIZOCTONIA SOLANI*) OF PEA UNDER FIELD CONDITIONS

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Abstract

Garden pea (*Pisum sativum* var. *hortense*), a crucial vegetable crop in the Fabaceae family, is primarily cultivated for its immature seeds. However, pea production in India faces challenges from various soil-borne diseases, particularly root rot caused by *Rhizoctonia solani*. *Rhizoctonia solani* is a significant pathogen affecting peas, especially in semi-arid regions like Rajasthan, UP, MP, Himachal Pradesh, Punjab, Haryana, Maharashtra, Bihar and Karnataka. The pathogen can survive in soil for long periods, complicating management efforts. Previous studies have highlighted the variability of pea genotypes in their resistance to root rot, emphasizing the need for ongoing resistance screening. The study was conducted at the Instructional Farm of S.K.N. College of Agriculture, Jobner, during the Rabi seasons of 2022-23 and 2023-24. A total of 48 pea varieties were screened using artificial inoculation with *R. solani* on sterilized sorghum grains. Disease incidence was monitored over 90 days, categorizing genotypes based on their resistance levels. The screening revealed varied reactions among the genotypes to *R. solani*. The incidence of root rot ranged from 12.98% in Lincoln to 57.66% in Arkel. None of the tested genotypes were immune to root rot. Four varieties demonstrated resistance, while 18 showed moderate resistance. The remaining genotypes varied from susceptible to highly susceptible. This study's findings align with previous research on the susceptibility of specific cultivars, underscoring the ongoing need for resistance evaluation against evolving pathogen strains.

PROKARYOTIC EXPRESSION OF NON STRUCTURAL 1 PROTEIN (NS1) OF AVIAN INFLUENZA (H5N1) VIRUS AND EVALUATION OF ITS IMMUNOGENICITY IN CHICKEN

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Abstract

Avian influenza poses a significant global threat due to its zoonotic potential and the associated economic losses in the poultry industry. Inactivated vaccines targeting various viral subtypes encounter challenges, particularly in distinguishing between infected and vaccinated animals (DIVA). The Nonstructural 1 (NS1) protein of avian influenza is conserved across all subtypes (H1-H16) and is only produced during viral replication, making it a suitable candidate for DIVA strategies. In this study, NS1 gene (801 bp) of avian influenza H5N1 subtype was amplified in RT-PCR and cloned in pET 28b (+) vector. The recombinant expression of NS1 (rNS1) was achieved in *E.coli* BL21(DE3) cells with a size of 36 kDa. The rNS1 was purified by Ni-NTA 6x HIS affinity tag and characterized with specific band in western blot using positive reference sera. The immunogenicity of rNS1 was evaluated by immunizing 6-8 week-old chickens with 10 µg of rNS1 formulated with aluminum hydroxide (Al(OH)₃) adjuvant. The immune response was monitored through an optimized indirect ELISA using rNS1 protein and a virus neutralization test (VNT). A significant antibody response was detected 14 days post-immunization and remained stable until day 21. However, administration of a booster dose on day 21 failed in a substantial increase in antibody titers. Furthermore, sera collected at 7-day intervals up to day 28 failed to neutralize the virus in VNT assays. These results indicate that the NS1 protein of avian influenza exhibits low immunogenicity, but it has potential utility in developing DIVA strategies for use with purified inactivated avian influenza vaccines.



EFFICACY OF INDIGENOUS AM FUNGI AGAINST *SCLEROTIUM ROLFSII*

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Abstract

Phytopathogens are a major threat to crop growth and yield. Biological control offers an eco-friendly alternative to chemical treatments and may enhance plant growth. This study focuses the biocontrol potential of native arbuscular mycorrhizal (AM) fungi against *Sclerotium rolfii* in brinjal (*Solanum melongena*). Forty native AM fungi isolates were isolated using wet sieving and decantation method. The pathogen was isolated from collar rot disease-infected brinjal plants. The isolates were screened under greenhouse conditions using brinjal as the host plant. Among these, ASAMF24, ASAMF10, and ASAMF18 demonstrated significantly increased root colonization (64.67 %, 63.33 %, and 60.33 %, respectively), and lowest disease incidence of 44 %. The AMF isolates also significantly increased PPO, peroxidase, and PAL activities in leaves. ASAMF10 exhibited the highest PPO (4.75), ASAMF24 showed highest peroxidase (4.95), and ASAMF10 also recorded the highest PAL (0.68), with ASAMF18 and ASAMF24 showing comparable results. With enhanced antioxidant enzyme activities, promoting root colonization, and reducing disease incidence, these isolates provide a sustainable alternative to chemical fungicides and improve plant resilience under stress conditions.

ISOLATION AND *IN VITRO* SCREENING OF FLUORESCENT PSEUDOMONADS AGAINST *SCLEROTIUM ROLFSII*

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Abstract

This study investigates the isolation and characterization of fluorescent pseudomonads from the rhizosphere soils of brinjal grown in the Gadag and Haveri districts of Karnataka, India. The aim was to identify potential biocontrol agents with antifungal activity against *Sclerotium rolfii*, a soil-borne pathogen. A total of 125 fluorescent pseudomonad isolates were obtained from brinjal rhizosphere in ten different locations across the two districts. Among them, only seven isolates viz., APF110, APF91, APF121, APF44, APF16, APF32 and APF17 inhibited the mycelial growth of the *S. rolfii* to an extent from 27.79 to 51.08 %. Among these, APF110 recorded significantly higher inhibition of 51.08 % followed by APF91 (46.33 %) and APF121 (42.07 %). Further evaluation of these isolates revealed that they possessed beneficial traits, including the production of indole acetic acid (IAA) and siderophores, as well as the ability to solubilize phosphorus (P), potassium (K), and zinc (Zn). The isolates also demonstrated resistance to chloramphenicol, nalidixic acid, and ampicillin, but were sensitive to kanamycin. These findings highlight the potential of these pseudomonad isolates as effective biocontrol agents, capable of promoting plant growth and contributing to sustainable agricultural practices.

EXPLORING HEAT TOLERANCE IN BREAD WHEAT: IMPLICATIONS FOR CLIMATE RESILIENCE

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Abstract

The study titled “Exploring Heat Tolerance in Bread Wheat: Implications for Climate Resilience” evaluated eight diverse



wheat genotypes (*Triticum aestivum* L.) under high-temperature stress. The parental genotypes HD 2864, MP 3336, Raj 3765, HD 2932, Raj 4238, Raj 3777, CG 1029, and HI 1134 were crossed in a half-diallel fashion (without reciprocals) using hand emasculation. Overall, HD 2864, Raj 4238, and CG 1029 were identified as desirable for grain yield and related traits based on the heat susceptibility index. The following crosses showed superior performance for seed yield and multiple traits under heat stress: HD 2864 x MP 3336, MP 3336 x Raj 3777, MP 3336 x HI 1134, Raj 3765 x CG 1029, HD 2932 x CG 1029, Raj 4238 x Raj 3777, Raj 4238 x CG 1029, and Raj 3777 x CG 1029. Based on heat tolerance (TOL), the parents HD 2864, HD 2932, Raj 4238, Raj 3765, and CG 1029 were also desirable for grain yield and key attributes. The crosses viz., HD 2864 x MP 3336, MP 3336 x Raj 3777, MP 3336 x HI 1134, Raj 3765 x CG 1029, HD 2932 x CG 1029, Raj 4238 x Raj 3777, Raj 4238 x CG 1029 and Raj 3777 x CG 1029 showed the superiority under heat stress environment for seed yield and more than two characters.

SMART AGRICULTURE

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Abstract

Agriculture plays vital role in the development of agricultural country. In India about 70% of population depends upon farming and one third of the nation's capital comes from farming. Since agriculture is the primary source of food grains and other raw materials, it is known as the basis of human life. For the nation's economic situation to improve, the agriculture sector must expand. Unfortunately, a large number of farmers continue to farm using old methods, which leads to low crop and fruit yields. Modern science and technology must therefore be applied in the agricultural industry in order to increase yield. Most of the papers signifies the use of wireless sensor network which collects the data from different types of sensors and then send it to main server using wireless protocol. The collected data provides the information about different environmental factors which in turns helps to monitor the system. Monitoring environmental factors is not enough and complete solution to improve the yield of the crops. Smart agriculture, which involves updating the current traditional methods of farming, is the only way to solve this issue. Therefore, the objective of the project is to use automation and Internet of Things technology to make agriculture smart. Smart GPS-based remote control is one of this project's distinctive characteristics. robot to carry out duties including weeding, spraying, detecting moisture, frightening animals and birds, and maintaining focus, Second, it combines intelligent decision-making based on precise real-time field data and smart irrigation with smart control. Thirdly, intelligent warehouse management includes theft detection, humidity control, and temperature maintenance. All of these functions will be managed using a remote smart device or personal computers with an Internet connection, and the microcontroller and raspberry pi will be used to interface sensors, Wi-Fi or ZigBee modules and cameras.

IMPACT OF CLIMATE CHANGE ON BIODIVERSITY AND FOOD SECURITY: A GLOBAL PERSPECTIVE

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Abstract

Climate change, driven by natural and human factors, significantly impacts biodiversity, agriculture, and food security, with narrowly adapted and endemic species at high risk of extinction. Species are shifting to higher altitudes and latitudes, with extinction rates ranging from 21–52% depending on migration scenarios. While phenotypic plasticity may buffer some species, many plants and crops face growth and yield thresholds beyond which they are compromised, particularly in rain-fed agricultural regions. For instance, agricultural yields in Africa could decline by over 30% by 2050. Addressing food security challenges through expanding agricultural land or exploiting new resources is costly and risks further biodiversity loss. Instead, solutions include mitigating food waste, conserving biodiversity, utilizing genetic resources, and leveraging traditional ecological knowledge. Strong policies, stress-resistant crop varieties, climate-resilient infrastructure, and sustainable practices like land restoration, bioenergy use, and community-based conservation are essential to balance food security and biodiversity conservation under climate change scenarios.



MITIGATING RISK AND AUGMENTING FARMER'S INCOME THROUGH LIVELIHOOD DIVERSIFICATION FRAMEWORK

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Abstract

Literature highlights livelihood diversification as an effective approach to increasing farmers' income, with risk being a key factor driving diversification decisions. Farmers' returns are closely linked to the level of risk they take. This paper explores factors influencing risk management and strategies to enhance income through diversification, ensuring sustainability of earnings. While diversification is a well-known income-boosting strategy, the study introduces a systematic approach using the Livelihood Diversification Framework (LDF). This approach aims to make diversification a proactive, non-distress-driven strategy through targeted interventions.

IMPACT OF CLIMATE CHANGE ON BIODIVERSITY AND FOOD SECURITY

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Abstract

Climate change poses a significant and multifaceted threat to biodiversity and food security, challenging ecosystems, agriculture, and human livelihoods worldwide. Rising global temperatures, shifting precipitation patterns, and increased frequency of extreme weather events disrupt natural habitats, leading to the loss of species and altered ecosystem dynamics. These changes adversely affect pollinators, soil health, and water resources, which are critical for agricultural productivity. Crops and livestock face stress from heat, drought, and pests, reducing yields and threatening food supply chains. Smallholder farmers, particularly in developing regions, are disproportionately affected due to limited adaptive capacities. Additionally, the erosion of genetic diversity among crops and livestock diminishes resilience against future climate stresses. Addressing these challenges requires integrated approaches, including promoting sustainable agricultural practices, conserving biodiversity, enhancing genetic resources, and developing climate-resilient crop varieties. Policymakers, researchers, and communities must collaborate to mitigate climate impacts and ensure food security for a growing global population while safeguarding the planet's ecological balance.

ADVANCES IN INTEGRATED PEST MANAGEMENT

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Abstract

Previous models of Integrated Pest Management primarily concentrated on the ecological dimensions of pest control. However, with the advent of new agricultural technologies, modern communication methods, evolving consumer preferences, heightened awareness of sustainably produced food systems, and the globalization of trade and travel, there is a pressing need to reassess the IPM framework to align it with contemporary requirements. IPM embodies a holistic and sustainable strategy for pest control, aiming to mitigate the economic, environmental, and health-related risks associated with pest management practices. IPM employs a diverse array of strategies, including cultural, biological, physical, chemical, and behavioural controls, to effectively manage pest populations while minimizing dependence on chemical pesticides. Essential elements of IPM encompass regular monitoring, establishing action thresholds, executing preventive strategies, and coordinating multiple control methods. Recent technological advancements, such as precision agriculture, remote sensing, and data analytics, have significantly improved the monitoring and decision-making capabilities within IPM. Additionally, the emergence of new biological control agents, microbiome-based strategies, and eco-friendly pesticides has broadened the resources available to growers for pest management. By fostering sustainability, resilience, and innovation, IPM presents a viable solution to the multifaceted challenges confronting modern agriculture, including climate change, pest resistance, and food security.



MEASUREMENT OF KNOWLEDGE LEVEL OF THE AGRI-HORTI-LIVESTOCK FARMING SYSTEMS OF ARID REGION OF WESTERN RAJASTHAN

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Abstract

Different Agri-Horti-Livestock component were taken for the study. Agri component comprises bajra, moong - bean , moth bean , cluster bean in khrief and chickpea , wheat , isabgoal, mustard ,fennel, jeera in rabi crops in livestock component among large ruminants buffalo, cow, camel are there and among small ruminant sheep , goat among horticulture components Vegetable cachri, tinda , onion, kakri, loki , among fruits , pomegranate, date palm , ber , mooringa , ker , sangri . Most of the farmers in Jaisalmer are following mono-cropping system either they are following horticulture or they going for crops and livestock or sole crops or sole horticulture and livestock are not common. Similarly sole livestock was not common other than Jaisalmer city. Knowledge level of the 75 farmers of Agri- Horti-Livestock will be measured by data collection Schedule. Agri – Horti - Livestock farmers were selected from five tehsils of Jaisalmer, Mohangarh, Pokaran, Bhaniyana, Falsund. Socio-economic data were collected from the farmers through the data collection schedule based on the socio-economic study of the knowledge level of the farmers. Total 75 farmers 15 each from each tehsil were taken to measure knowledge test /index. Knowledge test was used to measure the knowledge level of the farmers. Mean and standard deviation was used to categorize the farmers in low medium and high category Most of the farmers were fell in the medium knowledge level category remaining were fell in the low to higher level category.

EFFECT OF ENRICHED COMPOST AND CHEMICAL FERTILIZATION ON NUTRIENT UPTAKE BY MUSTARD CROP

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Abstract

A field experiment was conducted to evaluate the residual effect of rock phosphate and waste mica enriched compost on phosphorus and potassium supplying capacity under Mustard crop grown in Inceptisols. Enriched compost prepared using rice straw, rock phosphate, waste mica and *Aspergillus awamori* had higher chemical (total P, K, Ca, Mg and micronutrients) as well as biological properties (microbial biomass C, dehydrogenase, phosphatase activity and microbial biomass P) than chemical fertilizers. Application of enriched compost @5 t ha⁻¹ along with 50% recommended dose of fertilizer (RDF) to the crop resulted in a significant increase in mustard grain and Stover yield (2930 kg ha⁻¹ and 4937 kg ha⁻¹ respectively). Result showed that combined application of inorganic fertilizers and enriched composts significantly ($P < 0.05$) increased in N, P and K uptake by mustard over control. The grain (2840 kg ha⁻¹) and Stover (4707 kg ha⁻¹) yield of mustard crop was higher under treatment T₅ receiving enriched compost @ 6 t ha⁻¹ along with chemical fertilizers (50% RDF) compared to T₂ and control. Treatment T₅ recorded 56.68 and 74 per cent higher grain and stover yield of mustard, respectively over control. Thus, enriched compost could be an alternative source of water-soluble K fertilizers for crop production.

ADVANCES IN DISEASE AND PEST MANAGEMENT

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Abstract

Fields and Horticultural crops are affected by a number of diseases and pests caused by arthropods, bacteria, fungus, oomycetes, viruses and nematodes. Diseases and Pests impact on crop yield and quality, and also reduce resource usage. DNA-based technologies are likely to greatly increase the speed, sensitivity and accuracy of pest and pathogen detection and diagnosis. Rapid sequencing of nucleic acids from infected plants will aid identification of novel disease agents. Biomarkers of disease or crop damage such as volatile chemicals or blends may also be used to detect pest outbreaks. GM approaches will



facilitate combining resistance genes with different specificities and modes of action, thereby reducing the risk of directional selection for virulence. Analysis of the genomes of plant pathogens and invertebrate pests is already providing new information on genes, gene families and processes involved in host colonization and pathogenicity. Understanding the natural ecology of pests and pathogens, such as the factors determining host location, resource exploitation and interactions with other organisms, will improve our ability to manipulate behaviour, or exploit natural enemies or other antagonists of pest species. Worldwide, the use of plant protection products must comply with stringent regulations, aimed at reducing the risks and impacts on public health and the environment, avoiding the development of pest and pathogen resistance and preserving ecosystem services that benefit the biological control of pests. Alternative methods, such as biocontrol agents and semiochemicals, are becoming increasingly important in pest and disease management. The efficacy of chemical fungicides has been evaluated in terms of seed dressing, foliar applications scheduled based on epidemiological information and assessing fungicide sensitivity and including biocontrol agents. Harnessing new technologies and knowledge to create more durable resistant crops and sustainable disease and pest management systems will require improved understanding of the factors driving pest and pathogen adaptation and evolution.

ASSESSMENT AND EVALUATION OF DIFFERENT HOMEOPATHIC MEDICINES AGAINST FUSARIUM WILT OF TOMATO CAUSED BY *FUSARIUM OXYSPORUM* F. SP. *LYCOPERSICI* (SACC.) SNYDER AND HANSEN

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Abstract

Fusarium wilt caused by *Fusarium oxysporum* f. sp. *lycopersici* (Sacc.) Snyder and Hansen, poses a significant threat to tomato cultivation globally, particularly in tropical and subtropical regions where it can lead to yield reductions ranging from 20% to 80%. In India, management strategies focus on cultural practices, resistant cultivars, biological control and chemical treatments. Commonly used chemical pesticides such as Bromuconazole, Prochloraz, Carbendazim and Thiophanate-methyl face challenges like pathogen resistance and environmental and economic concerns. Therefore, there is a pressing need for sustainable and effective strategies. In response to these challenges, homeopathic medicines like *Arnica montana*, *Thuja occidentalis*, Sulphur, Silicea and *Calcarea carbonica* were evaluated for their efficacy against tomato wilt diseases. These treatments demonstrated significant inhibition of *Fusarium oxysporum* f. sp. *lycopersici*, where *Arnica montana* @ 0.2 % treatment showing the highest reduction in mycelial growth (73.43% compared to control). Seedling treatments with homeopathic medicines provided protection against both seed and soil-borne infections, while also promoting plant growth by increasing shoot and root length compared to untreated controls. Furthermore, foliar sprays of these treatments prior to pathogen inoculation effectively reduced disease incidence. The lowest disease incidence (15.58%) was recorded with *Arnica montana* @ 0.2 % treatment, compared to 71.87% in untreated controls at 60 days after transplanting. Notably, significant yield was observed with seedling treatment and one foliar spray of *Arnica montana* @ 0.2 %, yielding 1050 gm/plant. These findings underscore the potential of homeopathic treatments as sustainable alternatives in managing tomato wilt diseases.

INCREASING PRODUCTIVITY AND PROFITABILITY OF SOYBEAN THROUGH DIFFERENT AGRO CHEMICALS UNDER RAINFED CONDITIONS IN MAHARASHTRA REGION

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Abstract

The introduction of soybeans has increased cropping intensity, which has raised profitability per unit of land area. Soybean will persist as a significant rainfed oilseed crop in India. In Maharashtra, the economic exploitation of soybeans dates back almost forty years. The crop has demonstrated unparalleled expansion in both area and productivity throughout this time. In central and peninsular India's rainfed agro-ecosystem, soybeans have become a significant rainy season crop. This extraordinary growth has been the product of numerous bred kinds. Based on modelling studies and on-farm demonstrations,



the rainfed potential of soybean in India with current varieties is approximately 2.1 t/ha, compared with a national productivity average of only 1.2 t/ha. As a result, there are significant yield gaps between the potential and actual yields that farmers actually collect. The production of soybeans might double if this yield difference closes. By applying novel research techniques and taking advantage of recent developments in biology, it will be feasible to further increase the production of soybean grain and the quality of soybean oil. The National Agricultural Research System has so far been effective in satisfying the agricultural and industrial communities' needs for research.

USE OF BIOTECHNOLOGY FOR TRANSGENIC COTTON IMPROVEMENT IN AGRICULTURE

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Abstract

Transgenic cotton has been developed by introgressing one or more genes by either the use of genetic engineering or by advanced breeding programs. However, to counteract resistance against other insects and pests, these resistant varieties still need to be improved by introducing new genes. Farmers have effectively made use of Bollgard I and Bollgard II during their season. Transgenic cotton is one of the most valuable crops developed through transgenic strategies so far. Transgenic technologies are an important component of plant breeding pipelines today. Nowadays, any agricultural improvement strategy developed to meet the increasing challenges brought about by the growing population must take biotechnological advancements into account. In the last twenty years, biotechnology has presented enormous opportunities, chiefly in the form of new transgenic plants to fight biotic and abiotic stresses. The researcher has always faced challenges in the development and sustenance of cotton. Therefore, the use of gene editing technology, RNA interference, antisense technology, etc has now become popular in modifying and improving its phenotypic and genotypic traits. The result will additionally make it quicker for researchers to examine the desired feature, but it will also enable them to assist farmers who encounter difficulties with seasonal cultivation.

INSECT PESTS STUDIES WITH POPULATION DYNAMICS OF DIAMONDBACK MOTH (*PLUTELA XYLOSTELLA*) ON CABBAGE AND THEIR MANAGEMENT

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Abstract

Cabbage (*Brassica oleracea* L. var. capitata) is the most popular winter vegetables grown throughout India. It is used as salad, boiled vegetable and dehydrated vegetable as well as in cooked curries and pickles. The experiment was carried out at Instructional Farm of JNKVV-College of Agriculture, Rewa (M.P) during Rabi season 2020-2021. Studies conducted on the population dynamics of Diamond back moth of Rewa district region showed its infestation of diamondback moth started in the 2nd week of February with a mean average population of 0.26 larvae per plant. The population increased gradually and its peak with a mean of 4.3 larvae per plant during last week of March (13th SW). Thereafter, population reduced gradually. The pest showed a positive and significant correlation with the maximum temperature and minimum temperature, whereas maximum relative humidity and rainfall had non-significant correlation and minimum relative humidity has negative significant correlation with the DBM population. The efficacy of new molecule of insecticides i.e., Chlorantraniliprole 18.5 SC, Fipronil 5% SC, Indoxacarb 14.5 SC, Spinosad 45 SC, Novaluron 10 EC, Emamectin benzoate 5 SG, Bt and Neem oil were compared with untreated control plot against diamond back moth (*Plutella xylostella*). Stroller two sprays of insecticide were done at 15 and 35 days after transplanting of the crop. The effect of insecticide was recorded on 3, 7, 10 and 15 days after the insecticide. Mean population of DBM of two sprays showed that Spinosad 45 SC proved to be most effective and superior over rest of the treatments and recorded the lowest population of DBM (0.55 larva/plant). The order of efficacy of insecticides was found in



order T_4 (Spinosad 45 SC) > T_1 (Chlorantraniliprole 18.5 SC) > T_6 Emamectin benzoate > T_3 (Indoxacarb 14.5 SC) > T_2 (Fipronil 5% SC) > T_5 (Novaluron 10 EC) > T_8 (Bacillus thuringiensis 5% WP) > T_7 (Neem oil 0.15 %). The untreated control recorded maximum DBM larval population (3.35 larvae / plant). During field investigation total six species of insects and six species of natural enemies have recorded in Cabbage. Resulting in the head yield 320.00 q/ha Spinosad 45 SC @ 100 g a.i./ha with maximum C:B ratio (1:21.31) was recorded from Chlorantraniliprole 18.5 SC treatment followed by Indoxacarb 14.5 SC (1:18.20).

PERFORMANCE OF DIFFERENT *RHIZOBIUM* ISOLATES ON NODULATION AND GRAIN YIELD OF MUNGBEAN

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Abstract

This experiment was conducted at the Pulses Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (M.S.) field during *kharif* 2023-24 to evaluate the effect of various *Rhizobium* isolates of Mungbean on nodulation and grain yield of variety Green Gold. The experiment comprising of ten treatments including control and a treatment of recommended dose of chemical fertilizer with eight treatments of *Rhizobium* isolates which procured from different agro climatic regions of India. Experiment was laid out in randomized block design with three replications. The carrier-based culture of *Rhizobium* isolates was inoculated @ 25 g/kg of seed. The results of present study revealed that the seed inoculation of *Rhizobium* isolate (AMR-18-21) recorded higher grain yield (853 kg/ha) and maximum number of nodulation (21.60 nodules /plant) among the all the isolates of Mungbean.

USE OF ARTIFICIAL INTELLIGENCE TO ENHANCE AGRICULTURAL PRODUCTIVITY

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Abstract

The main one among them that is currently receiving attention on a global scale is its scientific improvement. The demand for food security is rising dramatically due to population growth across the globe. Farmers were not capable of meeting these requirements via traditional methods. Agriculture constitutes a key in the field that earns income. As a result, more effectively automated strategies were put forward. These ground-breaking methods provided food for the entire world while also providing a means of subsistence for billions of people. Thus, artificial intelligence (AI)-based technologies have proven successful in decreasing resource consumption, enhancing reliability and honesty, while concurrently boosting agricultural supply and grade and eradicating food wastage. AI is helping the modern agricultural framework to progress to another level. In the real-time agricultural era, selecting, interpreting, and marketing have all improved with artificial intelligence. productivity, crop performance, and a host of other elements. Socioeconomic principles will improve when artificial intelligence is used in agriculture, which might persuade growers to support and believe in it. The introduction of these platforms was aided by the development of an array of highly technologically advanced devices that are effective in determining a wide range of crucial elements, including the identification of weeds.

ENSURING FOOD SAFETY THROUGH USE OF AGRICULTURE PLANT GENETIC ENGINEERING ADVANCEMENT TECHNOLOGY

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Abstract

The field of plant genetic engineering can help to improve such feasible objectives through the emergence of



better-performing plants with enhanced resistance to various biotic and abiotic stresses such as herbicide tolerance and insect resistance in soybean and maize that are required due to the rising population and developing climatic challenges. A highly relevant issue of the twenty-first century is the problem of food security. The vehicles of genetic modification in crops can be a solution by using a technique known as gene stacking. The purpose of this method is to combine two or more genetically engineered characters or traits in crops with the use of plant breeding. The process of breeding resistance will be made much simpler by gene-stacking, which can also be customized for specific local pathogen populations. Global food security and the sustainability of agriculture could be considerably strengthened by breeding for permanent resistance to pests and diseases. Moreover, the other way to create genetically modified plants is to modify already-existing engineered plants to add one or more new transgenes or one way is to use a vector holding multiple transgenes to modify a non-genetically modified plant. Furthermore, this can help farmers to protect their crops from the effects of global warming and retain their output.

MITIGATING CLIMATE CHANGE BY USE OF MODERN TECHNOLOGIES IN AGRICULTURE

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Abstract

Most new technologies alter how agricultural inputs are used, frequently in ways that affect how the weather affects output and the way production affects greenhouse gas emissions. Numerous techniques have been used to reduce the impact of hunger and provide nourishing food to the expanding population to address the issue of food supply. The agricultural sector already encounters huge obstacles which are made worse by climate change. This is particularly apparent in developing nations. The population explosion era has resulted in an all-time high demand for food supplies. Amidst worldwide warming, agricultural innovations will become even more extremely important compared to what they currently constitute. By using innovative techniques like plant genetic engineering, molecular breeding, speed breeding, artificial intelligence, CRISPR-CAS technology, OMICS technology, and others, the burgeoning field of agricultural biotechnology is now helping crops to address these problems. These cutting-edge technologies will strengthen the agricultural industry's supply chain by delivering high-quality, timely crop productivity, and resistance varieties in the market. Furthermore, by giving farmers access to superior crop varieties, their problems will be relieved and their means of subsistence will be. These techniques can help to reduce the effects of global warming on crops by enhancing their characteristics to withstand harsh conditions.

INTEGRATED CROP DISEASE MANAGEMENT OF MINOR MILLETS IN ARID RAJASTHAN

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Abstract

Millets are coarse cereals from the Poaceae family that have been cultivated since the dawn of civilization. The most important cultivated species of small millets are finger millet, Foxtail millet, proso millet, barnyard millet, kodo millet, and little millet. Minor millets contain micronutrients such as Mg, Ca, Mn, Fe, K, Zn, tryptophan, phosphorous, fibre, and B vitamins. Small or minor millets are considered neglected crops due to their low yield potential in comparison to major millets (sorghum and pearl millet) and fine cereals (rice, wheat, and maize). Small millets are the traditional crops that are better suited to less fertile soils. There are several methods for controlling disease of minor millets, including cultural, chemical, and the use of resistant varieties. The usefulness of any method is determined by the farmers' economic and social circumstances. The use of resistant varieties is the most basic and cost-effective control method, and it can be combined with cultural and chemical control methods. Careful agronomic practises can help reduce their occurrence. Seed treatment, plant spacing, and regulating the amount of nitrogenous fertiliser applied to the crop are all important preventative measures. One farmer-inspired indigenous practise of using raw cow milk as seed treatment has been experimentally validated in farmers' fields and at C. R. Farm of the Central Arid Zone Research Institute, Jodhpur, by integrating with *Trichoderma spp.* (the farmer-friendly fungus and biocontrol agent). Smut disease appears on common millet earheads and can be controlled by treating the seed with copper fungicide.



STUDY PHYSIOLOGICAL TRAITS FOR HETEROSIS AND COMBINING ABILITY IN SESAME (*SESAMUM INDICUM* L.)

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Abstract

The investigation was undertaken to estimate heterosis of five characters in 36 hybrids of sesame obtained by crossing nine lines and four testers in line $\times$ tester mating design was performed at Instructional Farm, Dept. Agronomy, College of Agriculture, Junagadh Agricultural University, Junagadh. The analysis of variance revealed highly significant differences among the mean square due to genotypes, parents and hybrids for all the traits studied indicating a sufficient variability present in the material used. The three crosses viz., IC 43236 $\times$ AT 467, Zira 1 $\times$ G. Til-4 and JR 22 $\times$ AT 467 appeared to be most superior and recorded 33.83, 32.71 and 29.46 per cent higher yields, respectively over standard check. Two crosses viz., Zira 1 $\times$ G. Til-4 and JR 22 $\times$ AT 467 also exhibited higher heterotic response and sca effects in a desirable direction for yield attributing traits. Among the parents, Zira 1 and IC 43236 were found good general combiners for biological yield, chlorophyll content at 60 DAS, leaf area index(LAI) at 60 DAS and seed yield per plant (g). The cross combinations viz., JR 22 $\times$ AT 467 and Zira 1 $\times$ G. Til-4 were found to be good specific cross combinations for seed yield per plant. These crosses also depicted high sca effects for important seed attributes. Therefore, if it is commercially feasible, these two crosses could be exploited for a heterosis breeding programme to boost the seed yield in late *kharif* of sesame.

SOCIOLOGY BETWEEN BIG DATA AND RESEARCH FRONTIERS, A CHALLENGE FOR EDUCATIONAL POLICIES AND SKILLS

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Abstract

This paper examines the challenges faced by sociology and social research in the context of transformations brought about by the “data society.” It highlights key elements for advancing research at the intersection of sociology, educational policies, and skill development. While much of the literature emphasizes promoting data literacy, this paper advocates for a deeper focus on understanding data. Such understanding aligns with sociology’s foundational role in studying and explaining the complexities of social relationships across various contexts and time periods.

ALLELE MINING : A KEY FOR FUTURE

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Abstract

Detection and access to allelic differences that affects the phenotype of a plant is the most important aspect for efficient and purposeful utilization of genetic resources in development of a plant variety. During the process of evolution and domestication, a significant portion of undisclosed variants were left behind and were not used. The challenge is how to unlock this variation. Allele mining is a research field aimed at identifying allelic variation of relevant traits within genetic resource collections. It aims at identifying superior alleles of agronomically important genes from a wide range of crop species to suitably organize for the development of improved cultivars. It mainly helps in tracing the evolution of alleles, finding



allelic synteny, identification of new haplotypes and development of allele-specific molecular markers for use in MAS. Allele mining approaches include eco-tilling, sequencing and association mapping which are used for the recognition of sequence diversification for a given gene in the naturally occurring populations. Various bioinformatics tools such as PLACE, plant CARE, TRANSFAC, JASPAR, MEME, Plantprom DB, DCPD, SCPD, BioEdit, ClustalW2 and many more are required for sequence alignment. Various challenges associated with applications and approaches of allele mining have created curiosity among plant breeders to identify new 'mining' strategies for hastening the process of allele discovery and its utilization. Realizing the immense potential of this technique, concerted allele mining efforts are underway in many international crop research institutes on various crop species.

POPULATION DYNAMICS OF WHITEFLY AND BIHAR HAIRY CATERPILLAR IN BLACK GRAM IN VINDHAYA REGION

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Abstract

Black gram, *Vigna mungo* (Linn.) commonly known as urdbean, mash, or mashkalai, is the plant of the family Fabaceae and subfamily Papilionaceae. Because of its industrial and nutritional qualities, it is India's fourth-most significant short-duration pulse crop that contributes 10% of the country's total production of pulses. It is one of the major pulse crops cultivated in throughout India. It is consumed in the form of 'dal' (whole or split husked or unhusked). It is fed to milch animals specifically as a nutritious supplement and also grown as green manuring for providing organic manure in the soil. The field experiment was carried out at the Instructional Farm of the College of Agriculture, Rewa (MP) during the *Kharif* season of 2023. The observations on the incidence of Whitefly and Bihar hairy caterpillar were recorded from germination to harvesting of the crop at two times in a standard week. The population of whitefly ranged between 1.1 to 14.8/5 leaves/plant during July to October month. Weekly observation of whitefly revealed that peak population of whitefly observed during the 2nd week of September (37th SMW) i.e., 14.8/5 leaves/plant, when the crop was at reproductive stage (52 DAG day old crop). The correlation analysis revealed that the mean population of whitefly had positive correlation ($r = 0.64^*$) with maximum temperature. The population of Bihar hairy caterpillar ranged between 0.9 to 9.1/ mrl during August to October month. Weekly observation of Bihar hairy caterpillar revealed that the peak population of Bihar hairy caterpillar was observed during the third week of September (38th SMW) i.e., 9.1/ mrl, when the crop was at reproductive stage (59 DAG). The correlation analysis revealed that the mean population of Bihar hairy caterpillar had positive correlation ($r = 0.71^{**}$) with maximum temperature and also had positive correlation ($r = 0.60^*$) with morning relative humidity.

EVALUATION OF VARIOUS MODULES AGAINST YELLOW MITE, *POLYPHAGOTARSONEMUS LATUS* (BANKS) ON CAPSICUM (*CAPSICUM ANNUM* L.) UNDER PROTECTED CONDITIONS.

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Abstract

Field experiment was conducted under shade net house at Hi-Tech Horticulture farm, Rajasthan Agricultural Research Institute (Sri Karan Narendra Agriculture University, Jobner) Durgapura, Jaipur, (Rajasthan) to investigate the effectiveness of IPM modules on the reduction of yellow mite during summer 2014 and 2015 on capsicum (*Capsicum annum* L). The experiment comprised three modules along with local check replicated seven times under randomized block design. The treatments were imposed at an interval of 20 days, starting from initial notice of pest population up to 6 treatment spray observation.

The results revealed that during 2014 and 2015, all the treatments significantly reduce the population of yellow mite over



control. The findings revealed that module M-II, chemical intensive modules (imidacloprid 17.8 SL (0.0089%) - dimethoate 30 EC (0.051%) - emamectin benzoate 5 SG (0.002%) - fenazaquin 10 EC (0.02%) - dicofol 18.5 EC (0.37%) - acephate 75 SP (0.075%) proved significantly most effective reducing mite (52.48%, 72.05 %, 68.65%, 56.35%) at 1,3,7 and 15 days respectively. Module M-I, IHR based module comprising (profenophos 50 EC (0.1%) - NSKE 5% - emamectin benzoate 5 SG (0.002%) - *Verticillium lecanii* (0.004%) - fenazaquin 10 EC (0.02%) - profenophos 50 EC (0.1%) showed effective reduction mite (46.47%, 64.11%, 62.33%, 48.36 %) at 1,3,7 and 15 days respectively. Module M-III, bio-rational module comprising (imidacloprid 17.8 SL (0.0058%) - azadirachtin 0.15 EC (0.0003%) - emamectin benzoate 5 SG (0.002%) - NSKE (5%) - *Verticillium lecanii* (0.004%) - imidacloprid 17.8 SL (0.0058%) observed least effective against mite (38.69 %, 49.31 %, 50.13 % 40.49%) at 1,3,7 and 15 days respectively. The minimum leaf curling damage was observed 7.15 %, 6.79%, 5.35 % at 7, 11 and 13 Week after transplanting respectively in Module M-II. Module M-I, showed next order of effectiveness 10 %, 12.15 %, 9.65 % at 7, 11 and 13 WAT respectively. Module M-III, showed least order of effectiveness 14.29 %, 15.72 %, 14.29 % at 7, 11 and 13 WAT respectively. Study revealed that imidacloprid 17.8 SL @ 0.5 ml/l, dimethoate 30 EC @ 1.7 ml/l, emamectin benzoate 5 SG @ 0.4 gm/l, fenazaquin 10 EC @ 1 ml/l, dicofol 18.5 EC @ 2 ml/l and acephate 75 SP @ 1 gm/l can be spray for the management of yellow mite on capsicum under shade net house conditions during summer for off season production.

SYMPTOMATOLOGY, ETIOLOGY AND MANAGEMENT OF ALTERNARIA LEAF BLIGHT DISEASE OF CABBAGE : A REVIEW

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Abstract

Cabbage (*Brassica oleracea* var *capitata*) a major vegetable cole crop belongs to family Cruciferae. The demand for makes it one of the fastest hikes in consumption due to nutritive value. For increase it production and area there is need to make strategies on effective disease control. A number of fungal bacteria and nematode diseases threaten to crop. Among them leaf blight is most important disease of the crop incited by different fungal species of *Alternaria* viz. *Alternariabrassicaceae*, *A. brassicola*, *A. raphani* and these pathogens affect leaves often head rot results in devastating heavy losses to crop in terms of quantity and quality as well. Symptoms appears as dark circular spots surrounded by yellow halo on leaf surface, as disease progresses spots increase in size become develop target pattern of concentric ring having chlorotic border, are usually gray to tan or blackish in color and in severe infection defoliation occurs. The pathogens are seed as well as soil borne in nature, that's why seed is the primary source of inoculum. Epidemiologically atmospheric temperature from 20-30 °C and higher relative humidity favor to increase mycelial growth and sporulation of the fungus and disease development. To control this disease employed a variety of strategies i.e. integrate disease management including cultural practices, use of biocontrol agents, plant activators, phytoextract, resistant varieties and fungicides, among these the most often utilized strategies is the introduction of resistant cultivars/varieties to reduce disease severity. Use of genetic resistant varieties to avoid disease is lasting, locally appropriate and ecologically safe. However, the commonest strategies to management of disease by farmers is to use of fungicides due to limited availability of resistant varieties in many parts of the world.

GROWTH, PRODUCTIVITY, AVAILABLE NITROGEN, AVAILABLE PHOSPHORS, AVAILABLE POTASSIUM, AVAILABLE SULPHUR INFLUENCED BY DIFFERENT PLANT SPACING AND NITROGEN LEVELS OF MAIZE (*ZEA MAYS* L.) IN BATHINDA DISTRICTS OF PUNJAB

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Abstract

A field experiment was conducted during (Kharif) seasons of 2023 at the Guru Kashi University, Talwandi Sabo, Bathinda, Punjab, to effect of different plant spacing and nitrogen levels on growth, productivity and available NPK of maize. The



experiment was laid out in a split plot design with three replications, under three plant spacings of 45 cm x 15 cm, 55 cm x 20 cm, and 65 cm x 25 cm were included in the treatment plan, along with four nitrogen levels: control (75% of RDN (31.5 kg N/ha), 100% of RDN (42 kg N/ha), and 125% of RDN (52.5 kg N/ha). At every stage of the crop's growth, the leaf area index (LAI) with 125% of RDN was the highest and much better than that with 75% and 100% of RDN. Throughout the crop's growth stages, the spacing of 55 cm by 20 cm generated the least amount of dry matter. At a 45 cm X 15 cm spacing, the highest grain weight of 30.33 g was attained, which was comparable to the remaining plant spacing. At 55 cm X 20 cm, the lowest grain yield (52.76 q/ha⁻¹) was observed. With respect to nitrogen, highest harvest index (34.74%) was associated with application of 75% of RDN which was significantly superior over 100% of RDN. With respect to plant spacing significantly highest harvest index (36.64 %) was recorded at 45 cm X 15 cm and lowest harvest index (31.98%) was recorded with 65 cm X 25 cm and it was on par with 55 X 20 cm (33.24 %). With regard to plant spacing, higher soil available nitrogen and phosphorous was recorded at spacing of 65 cm X 25 cm, higher available potassium at spacing of 45 cm X 15 cm.

NUTRITIONAL, ANTIOXIDANT AND ANTI- MICROBIAL PROPERTIES OF CROTALARIA JUNCEAE FLOWERS

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Abstract

Crotalaria juncea known as brown hemp, Indian hemp, or sunn hemp, is a tropical Asian plant of the legume Family fabaceae. It is generally considered to have originated in India. It is now widely grown throughout the tropics and subtropics as a source of green manure, fodder and lignified fibre obtained from its stem. The plant possessed hypolipidemic, reproductive, antioxidant, antibacterial, antifungal, anti diarrhoeal, anti-inflammatory, hepatoprotective, anti-diabetic and many other pharmacological effects. Flowers are borne on clusters known as raceme that is up to 10 - 25 cm long, each inflorescence has 8 - 20 flowers. The nutritional composition of *Crotalaria juncea* flower includes Carbohydrate (53.48g), Protein (26.56g), Crude fat (1.52g), Crude Fiber (12.12g) per 100g. The total phenolic (5.65 g GAE/ml) and flavonoid (0.43 g QE/ml) contents were observed in the 100 g/ml CJ flower ethanol extract. The phytochemical screening of the *Crotalaria juncea* flowers revealed the presence of carbohydrates, aminoacids, volatile oils, alkaloids, flavonoids, saponins. The GC-MS study of the flower reveals that the flower is rich source of ethyl - 2-Ethyl-oxetane, Octane, Sabinyl, 2-methylbutanoate, Butanoic acid, 3-oxo-, 1-methylpropyl ester, Butanoic acid, 1-methylpropyl ester, 1-Octanol, Tetradecane, 2-Butanone, Benzaldehyde, Hexadecane, 1H-Purin-2-amine, 6-methoxy-N-methyl, 3-Buten-2-one, 2-Piperidinone, 2-Pentanone, Octadecane, 2-Piperidinone, 2-Pentadecanone, Phthalic acid, isobutyl octadecyl ester, Hexadecanoic acid, methyl ester, Octadecadienoic acid, methyl ester; 9,12-Octadecadienoyl chloride, Methyl stearate, Hexadecanoic acid, 2-methylpropyl ester and Oleic Acid. The active phytoconstituents has shown antimicrobial activity against six human pathogens, including the fungi *Microsporum gypseum* and five Gram-positive bacteria (*Propionibacterium acnes*, *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Streptococcus pyogenes*, and *Streptococcus mutans*), as well as one Gram-negative bacterium (*Escherichia coli*). In conclusion, CJ flower extracts have a significant amount of polyphenols and flavonoids, which contribute to the health-promoting properties. The extracts exhibit promising effects, including antioxidant properties, antimicrobial activities against a wide range of bacteria and fungi.

A COMPREHENSIVE STUDY OF INSECT PEST *SPODOPTERA LITURA* ON COTTON PLANT IN VIVO AND IN VITRO APPROACH FOR MANAGEMENT OF *SPODOPTERA LITURA* (F.) AND ITS SOCIOECONOMIC IMPORTANCE

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Abstract

The genus *Spodoptera* includes important polyphagous insect species and these are primary and secondary pests of many



crops especially cotton. The leaf-eating caterpillar (*Spodoptera litura* Fabricius) belongs to family *Noctuidae*, is serious polyphagous pest in Asia as well as widespread on global level, causing extensive damage to a variety of different crops viz., pulses, soybean, chrysanthemum, cotton, oilseeds, vegetables, tobacco, banana and groundnut. This pest is one of the most major pests causing economic loss at global level including Japan, India, China, Pakistan and other Southeast Asian nations. In India, *Spodoptera litura* is a particularly notorious pest, affecting more than 74 cultivated crops along with wild plants. During the rainy season, its impact intensifies, leading to substantial yield losses, especially in cotton and groundnut crops, where it can cause a devastating reduction in yield ranges 26-100%. This pest is indigenous to South Asia and known for its strong flying capabilities which allows it to disperse over a longer distance during the *summer* months. *Spodoptera litura* has remarkable capabilities and camouflage mechanism to hide itself and its eggs from predators by covering it with her abdominal scales.

The Indian farmers often resort to multiple applications of synthetic insecticides and pesticides to combat against this relentless pest during the crop season of economically vital and cash crops. However, the over-reliance on methods of chemical control underscores the need for sustainable and eco-friendly pest management strategies to mitigate the damage caused by *Spodoptera litura*. This polyphagous insect targets more than 200 plant species worldwide including various crop species being cultivated in India. The increasing ineffectiveness of pesticides and adverse consequences of their indiscriminate application have spurred the development of eco-friendly pest management strategies that minimize residual effects. This shift toward sustainable pest management is crucial for mitigating the impact of *Spodoptera litura* on agriculture.

MANAGEMENT OF FRUIT FLY, *ZEUGODACUS CUCURBITAE* OF BOTTLE GOURD USING BOTANICALS

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Abstract

Fruit flies (Diptera: Tephritidae) are a major pest of agricultural commodities all over the world, causing 30 to 100% yield losses, therefore, field trials were conducted to evaluate efficacy of seven botanical to manage *Zeugodacus cucurbitae* (Coquillett) infesting bottle gourd. Out of seven botanicals the azadirachtin 0.03% was found most effective fruit fly infestation followed by NSKE and karanj oil was ranked as least effective against fruit fly. The maximum yield of bottle gourd 282 q ha⁻¹ was obtained from the plots treated with azadirachtin 0.03% followed by NSKE 280 q ha⁻¹ fruit yield. While the minimum fruit yield was obtained in the untreated plot (260 q ha⁻¹) followed by karanj oil (268 q ha⁻¹). The maximum incremental benefit-cost ratio was obtained from the plot treated with tumba crude extract (1:9.91) While the minimum benefit cost ratio (1:2.20) in karanj oil.

BIOTECHNOLOGY AND CROP IMPROVEMENT

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Abstract

Plant biotechnology, a major component of agricultural biotechnology, deals with various aspects of plant tissue culture, genetic transformation, and molecular biology techniques. Tissue culture methods offer a rich scope for creation, conservation, and utilization of genetic variability for the improvement of field, fruit, vegetable, and forest crops, and medicinal/aromatic plants. Micropropagation technology ensures true to type, rapid and mass multiplication of plants that possesses special significance in vegetatively propagated plant species. This technology has witnessed a huge expansion globally, with an estimated global market of 15 billion US\$/annum for tissue-culture products. Some basic techniques of tissue



culture, such as anther/microspore culture, somaclonal variation, embryo culture, and somatic hybridization, are being exploited to generate useful genetic variability for obtaining incremental improvement in commercial cultivars. Production of secondary metabolites, such as food flavors, food colors, dyes, perfumes, drugs, and scented oils used in aromatherapy, through cell cultures and hairy root cultures, are leading examples of molecular farming. Cryopreservation of germplasm at the cell/tissue/organ levels, in liquid nitrogen at -196°C, is highly rewarding for establishing germplasm banks, especially for vegetatively propagated crops and rare, endangered plant species. During the past 15 years, remarkable achievements have been made in the production, characterization, field evaluation, and release of transgenic varieties/hybrids in several crops. Transgenic varieties/hybrids of maize, cotton, soybean, potato, tomato, and papaya are now being commercially grown on about 134 million hectares spread across 25 countries. Research in genomics allows high-resolution genetic analysis for physical mapping and positional gene cloning of useful genes for crop improvement. Molecular (DNA) markers help in precise characterization of germplasm, construction of saturated linkage maps, and DNA fingerprinting of crop varieties. Molecular markers are now increasingly being used for marker-assisted gene pyramiding and alien gene introgression. Current research, involving large-scale DNA sequencing, microarrays, and robotics, is heading towards gene revolution and nanobiotechnology.

CLIMATE-SMART HORTICULTURE: INNOVATIONS FOR SUSTAINABLE CROP PRODUCTION AND RESILIENCE

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Abstract

Climate-smart horticulture is emerging as a pivotal strategy to address the dual challenges of food security and climate change. This approach integrates resilient crop improvement, advanced biotechnology, precision horticulture, and agroecological practices to create sustainable, high-yielding, and climate-resilient horticultural systems. Through the development of climate-tolerant crop varieties using both conventional breeding and genetic engineering, climate-smart horticulture seeks to mitigate the effects of extreme weather conditions, pests, and diseases intensified by climate change. Biotechnological advancements such as CRISPR-based gene editing and transgenic approaches allow for precise modifications to enhance crops' stress resistance and nutrient content, supporting both human health and agricultural sustainability. Precision horticulture optimizes resource use efficiency by integrating data-driven technologies, such as soil moisture sensors, remote sensing, and automated irrigation, to ensure inputs like water and fertilizers are applied precisely where needed, reducing waste and environmental impact. Agroforestry, a complementary aspect of climate-smart horticulture, promotes biodiversity and carbon sequestration, further contributing to the resilience of farming ecosystems. By combining these innovations, climate-smart horticulture not only boosts productivity but also strengthens resilience to climate-related risks, supporting global food security. This holistic approach necessitates policy support, research investment, and farmer education to fully harness its potential, aligning agricultural practices with environmental conservation goals for a sustainable future.

RELEVANCE OF ADVANCED PLANT DISEASE DETECTION TECHNIQUES IN DISEASE AND PEST MANAGEMENT FOR ENSURING FOOD SECURITY AND THEIR IMPLICATION

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Abstract

Plant diseases and pests present significant challenges to global food security, leading to substantial losses in agricultural productivity and threatening environmental sustainability. As the world's population grows, ensuring food availability becomes increasingly urgent. This review explores the significance of advanced plant disease detection techniques in disease and pest management for enhancing food security. Traditional plant disease detection methods often rely on visual inspection and are time-consuming and subjective. This leads to delayed interventions and ineffective control measures. However, recent



advancements in remote sensing, imaging technologies, and molecular diagnostics offer powerful tools for early and precise disease detection. Big data analytics and machine learning play pivotal roles in analyzing vast and complex datasets, thus accurately identifying plant diseases and predicting disease occurrence and severity. We explore how prompt interventions employing advanced techniques enable more efficient disease control and concurrently minimize the environmental impact of conventional disease and pest management practices. Furthermore, we analyze and make future recommendations to improve the precision and sensitivity of current advanced detection techniques. We propose incorporating eco-evolutionary theories into research to enhance the understanding of pathogen spread in future climates and mitigate the risk of disease outbreaks. We highlight the need for a science-policy interface that works closely with scientists, policymakers, and relevant intergovernmental organizations to ensure coordination and collaboration among them, ultimately developing effective disease monitoring and management strategies needed for securing sustainable food production and environmental well-being.

IMPACT OF DIPLOMA IN AGRICULTURE EXTENSION SERVICES FOR INPUT DEALERS (DAESI) PROGRAMME GAIN IN KNOWLEDGE THROUGH ONE YEAR TRAINING PROGRAMME IN NAGOUR DISTRICT OF RAJASTHAN

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Abstract

In view of recent advancement in the agricultural technologies and more and more involvement of Input Dealers in agriculture, the role of Input Dealers is not just to educate the Input Dealers regarding agriculture technologies but they have to pay equal attention towards dissemination of agro-based new technologies for the socio-economic upliftment of the rural families. Hence, the National Institute of Agricultural Extension Management (MANAGE) has launched a program titled “Diploma in Agricultural Extension Services for Input Dealers (DAESI)” to enhance the technical competency of input dealers with a view to facilitate better advisory to the farmers. Currently, this program is being implemented as a Central Sector Plan Scheme with the help of various Nodal Training Institutes (NTIs) such as Agricultural University, Krishi Vigyan Kendra’s, Farmers’ Training Centres, Agricultural Technology Management Agency (ATMA), Directorate of Extension Education etc. For this, it is imperative that these functionaries should have through knowledge in agriculture and allied areas. Keeping this in view a 48 days training on agriculture information ,and new agricultural technology for Input Dealers was organized at Krishi Vigyan Kendra, Maulasar Nagaur-II in collaboration with MANAGE Hyderabad.

ROLE OF PRECISION TECHNOLOGY IN INCREASING VEGETABLE PRODUCTION AND RESOURCES USE EFFICIENCY

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Abstract

Precision agriculture technologies are transforming vegetable production by enhancing resource use efficiency and improving yields while minimizing environmental impacts. This approach integrates advanced tools such as global positioning systems (GPS), geographic information systems (GIS), remote sensing, variable rate technologies (VRT), and decision support systems (DSS) to monitor and manage crop growth with exceptional precision. By tailoring inputs like water, fertilizers, and pesticides to the specific needs of the crop and soil, precision technologies address inefficiencies and reduce wastage. In vegetable production, these technologies enable site-specific management practices that consider spatial and temporal variability in the field. Remote sensing and drones provide real-time data on crop health, soil moisture, and nutrient levels, facilitating timely interventions. Variable rate application of water and nutrients ensures optimal plant growth, reduces input costs, and conserves valuable resources. Technologies such as automated planting and harvesting systems further improve operational efficiency and reduce labor costs. The adoption of precision agriculture also supports sustainable farming by



reducing greenhouse gas emissions, preventing over-application of chemicals, and improving soil health through targeted practices. For high-value vegetable crops, precision tools help optimize yield and quality, meeting market demands while maintaining profitability. Despite the benefits, barriers such as high initial investment, technical complexity, and limited access to expertise hinder widespread adoption, particularly for smallholder farmers. Addressing these challenges through policy support, farmer training, and cost-sharing initiatives is crucial for broader implementation. This abstract underscores the transformative potential of precision agriculture technologies in enhancing vegetable production and resource use efficiency. By promoting sustainable practices and addressing limitations, these innovations pave the way for a resilient and productive vegetable farming sector capable of meeting the growing global demand.

BIO EFFICACY OF DIFFERENT ACARICIDES AGAINST RED PALM MITE, *RAOIELLA INDICA* HIRST (ACARI: TENUIPALPIDAE) ON DATE PALM

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Abstract

The experiment was conducted at the Date Palm Research Centre, Swami Keshwanand Rajasthan Agricultural University, Bikaner, spanning from July 2021 to June 2023. The western belt of Bikaner district of Rajasthan encompass a unique date palm based agrarian ecosystem with considerable area under cultivation; playing a key role in the economy of the region. The red palm mite, *Raoiella indica* Hirst, is a predominant pest of date palm, coconuts and other palm species in different parts of the world. The RPM introductions have caused severe damage to date palm in the western part of Rajasthan region. The work presented herein is the result of several acaricides trials conducted in Bikaner on date palm in order to provide chemical control alternatives to minimize the impact of this pest. Spiromesifen, chlorfenapayar and propargite were most effective in reducing the population of *R. indica* in date palm. Spray treatments with ethion, dicofol and abamectin showed middle order of mite control. In addition, the acaricides wettable sulfur, imidacloprid and thiamethoxam were able to least effective reduce the population of *R. indica* in date palm trials in Bikaner region of Rajasthan.

HETEROSIS ESTIMATION IN PAPAYA PROGENIES DERIVED FROM LINE × TESTER MATING DESIGN FOR KEY AGRONOMIC TRAITS

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Abstract

Heterosis, a term introduced by Shull in 1914, refers to the superiority of F1 hybrids over their parents, signifying improved fitness and vigor. In papaya breeding, notable crosses demonstrated significant heterosis for key traits. Early flowering is a desirable trait, with crosses like AC-119 × Co-4 and Dwarf Lily × Co-4 exhibiting the highest negative heterobeltiosis (-14.03% and -14.33%, respectively), highlighting their potential for developing early-maturing hybrids. Plant height reduction, advantageous for management, was evident in hybrids such as Line-21 × Coorg Honeydew (-35.81%) and Pant Papaya-2 × Coorg Honeydew (-30.62%). These crosses are promising for creating compact plant varieties. Increased leaf number enhances photosynthetic efficiency, with hybrids like 4 × 1 (20.69%) and 6 × 1 (30.43%) showing significant positive heterobeltiosis. Similarly, robust stem girth, essential for plant strength, was observed in crosses like Washington × Lucknow (13.92%) and Pant Papaya-2 × Co-4 (5.38%). The number of fruits per plant, a critical yield-related trait, showed marked heterobeltiosis in hybrids such as Arka Prabhat × Coorg Honeydew (48.81%) and AC-119 × Lucknow (37.39%). Additional traits like fruit weight, diameter, length, pulp thickness, and total soluble solids also demonstrated significant heterosis in select crosses, underscoring their superiority over parents and commercial checks. For instance, Red Indian × Lucknow



exhibited high heterobeltiosis for fruit weight (48.72%). Collectively, these results underscore the potential of specific crosses in enhancing papaya breeding programs, emphasizing traits such as early flowering, reduced plant height, and improved fruit characteristics for greater agronomic and commercial success.

IMPORTANCE OF SOIL HEALTH MANAGEMENT FOR SUSTAINABLE AGRICULTURE

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Abstract

Soil, the uppermost layer of the earth's crust, is formed through various physical, organic and chemical processes. Over 99.7% of our food comes from the soil. Soil health is critical for sustainable agriculture and environmental conservation. Effective soil health management practices enhance soil structure, fertility, and biodiversity, leading to improved crop productivity and resilience against climate change. The various practices aimed at maintaining and improving soil health, including cover cropping, crop rotation, reduced tillage, organic amendments, and agroforestry. Cover cropping and crop rotation enhance soil nutrient availability and microbial activity, while reduced tillage minimizes soil erosion and maintains structure. The application of organic amendments, such as compost and manure, increases soil organic matter and nutrient content. Agroforestry integrates trees with crops, improving soil stability and water retention. The adoption of these practices not only contributes to agricultural productivity but also fosters ecosystem services such as carbon sequestration and water filtration. Challenges to implementation, including economic constraints and knowledge gaps among farmers, are discussed, alongside strategies for promoting adoption. Overall, a holistic approach to soil health management is essential for ensuring food security and environmental sustainability in the face of growing global challenges.

IN-VITRO EVALUATION OF BOTANICALS AND NOVEL FUNGICIDES AGAINST RICE BLAST PATHOGEN

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Abstract

Rice (*Oryza sativa* L.) belongs to family Poaceae also known as Gramineae. More over half of the population of world relies on as a staple diet which making it the second most extensively produced cereal crop. Numerous biotic and abiotic elements have an impact on productivity and significantly reduce rice crop yields worldwide. Among the fungal diseases bound to rice, blast disease is one of the most devastating disease affecting production of rice globally. All the rice ecosystems are affected by blast disease in India yield losses due to blast could be as high as 50% when the disease attains an epidemic proportion. Systemic fungicide including tricyclazole and carbendazim are the integral part of disease management strategy used by farmers. Systemic fungicides are often able to effectively control plant disease, but some fungicides result in serious environmental and health problems. Nine botanicals were tested *in-vitro* against *Pyricularia oryzae* using the food poisoning method, and it was found that datura leaf extract was highly effective in controlling the growth of *P. oryzae* while garlic clove extract was the least effective. The result of bio-assay of fungicides revealed that combi-fungicide (i.e., Tebuconazole 50% + Trifloxystrobin 25% WG, carbendazim 12% + mancozeb 63% WP) and Tricyclazole 75%WP showed 100% efficacy while Tebuconazole 25.9 w/w EC was least effective at all the concentration in controlling the pathogen under *in-vitro* condition.

AMMI AND GGE BILOT ANALYSIS FOR YIELD AND RELATED TRAITS IN RICE (*ORYZA SATIVA* L.) UNDER HUMID SOUTH-EASTERN PLAIN ZONE OF RAJASTHAN

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Abstract

15 rice varieties were evaluated for grain yield stability in three different environments representing different seasons under the humid south-eastern plain zone in Rajasthan during *kharif* 2019, 2020 and 2021. Additive main effect and multiplicative interaction (AMMI) and stability model were employed to study the $G \times E$ interaction. ANOVA revealed significant differences among varieties and locations along with significant $G \times E$ interaction. The mean grain yield among the varieties varied from 40.20 to 56.80 q/ha with the general mean of 46.57 q/ha. Variety MTU1010 was identified to have higher mean grain yield than general mean and was stable across the locations. AMMI analysis revealed that the first two IPCA scores together explained 87.26 % of the total interaction variance. Specifically, Biplot graphical analysis showed that variety DR46 exhibited the best overall yield performance. Variety DR46 and NDR359 recorded a better performance in environments E1 and E3, while KARJAT performed well in E1 and E2 environments, hence could be identified for specific location. These varieties could be utilized for direct cultivation as well as for improvements of other cultivars.

SOIL HEALTH AND ITS IMPROVEMENT THROUGH AGRONOMIC APPROACHES

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Abstract

Soil is an important natural resource providing water, nutrient, and mechanical support for plant growth. In agroecosystem, continuous manipulation of soil is going on due to addition of input, removal of nutrients, changing water balance, and microbial life. These processes affect soil properties (physical, chemical, and biological), and the deviation of these properties from the normal status is controlled by soil buffering capacity and soil resilience. If these changes are beyond the reach of soil resilience, then soil loses its original state, leading to soil degradation. At present, the extent of the degraded area in the world is 1,036 to 1,470 million ha. This urges the need for maintaining soil health rather than the mere addition of input for crop production. Soil health is an integrative property that reflects the capacity of soil to respond to agricultural intervention, so that it continues to support both agricultural production and the provision of other ecosystem services. Maintaining the physical, chemical, and biological properties of soil is needed to keep it healthy, and this is possible through the adoption of different agronomic approaches.

UNLOCKING THE SECRETS TO THRIVING CROPS: A HOLISTIC APPROACH

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Abstract

Picture a farmer in a field full of healthy, green crops. This beautiful sight doesn't just happen by chance; it comes from a mix of important factors that work together to help crops grow strong and healthy. Let's look at the key elements that make this possible. Cropping Systems are one of the first things to consider. Using different planting strategies, like rotating crops or planting two crops together, helps keep the soil healthy and reduces pests. By changing what they plant each season or mixing different crops, farmers can make the most of their land while encouraging a variety of plants and animals to thrive. Next up are agronomic practices, which include the day-to-day actions farmers take to care for their crops. This means things like planting seeds at the right time, watering them properly, and controlling pests effectively. When farmers pay attention to local conditions and adjust their practices accordingly, they can give their crops the best chance to grow. Soil health management is also crucial. Healthy soil is full of nutrients and good microorganisms that help plants grow. Farmers can improve soil health by using cover crops (plants grown to protect and enrich the soil), reducing tillage (not disturbing the soil too much), and



adding organic matter like compost. These practices lead to better water retention and stronger crops. Another important factor is farm mechanization. Using modern tools and machines helps farmers work more efficiently. With the right equipment, tasks like planting and harvesting can be done much faster, which is important for getting the crops in and out at the right time. Lastly, Indigenous Technical Knowledge (ITK) offers valuable insights. This is the traditional knowledge that farmers have passed down through generations. It can provide unique ways to farm sustainably and work with local environments. In summary, thriving crop productivity is about using a combination of smart planting strategies, good farming practices, healthy soil, modern technology, and traditional wisdom. By bringing all these elements together, farmers can grow healthier crops and contribute to a more sustainable future for agriculture.

EFFECT OF AGE OF HOST AND INOCULUM DENSITY ON DEVELOPMENT OF ANTHRACNOSE DISEASE ON ORGANICALLY GROWN CHILLI PLANTS

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Abstract

Chilli (*Capsicum annum* L.) is an important spice-cum vegetable crop. It suffers from several fungal, bacterial and viral diseases that cause quantitative and qualitative losses, among them; anthracnose or ripe fruit rot caused by *Colletotrichum capsici* is a major disease of economic importance which hampers sustainable chilli production. Investigations were undertaken on effect of age of host and inoculum concentration on development of anthracnose disease on organically pot grown chilli plants under artificial epiphytotic conditions. In the present investigation the susceptibility of chilli plants to anthracnose gradually increased with increasing plant age and after reaching to age of 40 days after transplanting (DAT) to its maximum started declining as plants mature. In general, as pepper plants grew older, they became more resistant to *C. capsici*. Maximum disease was observed in the plants ageing 40 DAT with PDI 62.0. Minimum disease was observed in the plants ageing 20 DAT with PDI 16.2. Disease incidence increased with the increased inoculum level from 1×10^3 to 1×10^6 conidia ml^{-1} .

GREEN SYNTHESIS AND ANTIBACTERIAL POTENTIAL OF ZINC OXIDE NANOPARTICLES AGAINST *XANTHOMONAS ORYZAE* PV. *ORYZAE*

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Abstract

Green synthesis of nanoparticles offers numerous advantages over conventional physico-chemical methods, including eco-friendliness, cost-effectiveness, and biocompatibility, with wide-ranging applications in Agriculture field. In the present study, zinc oxide (ZnO) nanoparticles (NPs) were synthesized using *Melia azedarach* leaf extract. Zinc nitrate hexahydrate (0.02 M) served as the precursor for ZnO NP synthesis in the prepared leaf extracts. The structural and optical properties of the ZnO NPs were analyzed using X-ray diffraction (XRD), Fourier transform infrared (FTIR) spectroscopy, scanning electron microscopy (SEM), and ultraviolet-visible (UV-Vis) spectrophotometry. The antibacterial potential of the ZnO NPs was evaluated using the well diffusion method against *Xanthomonas oryzae* pv. *oryzae* (Xoo), based on the zone of inhibition. A color change in the reaction mixture from brown to yellowish indicated the formation of ZnO NPs. The UV-Vis absorption spectrum showed a peak at 313 nm, while the XRD pattern matched the Joint Committee on Powder Diffraction Standards (JCPDS) card for ZnO, confirming the presence of pure ZnO NPs. FTIR analysis further validated the involvement of bioactive functional groups in the reduction of bulk zinc nitrate to ZnO NPs. SEM imaging revealed the spherical morphology of the synthesized NPs, and transmission electron microscopy (TEM) indicated a size of 6.28 nm. The ZnO NPs synthesized



using *M. azedarach* leaf extract exhibited significant antibacterial activity against *Xoo*, with the highest zone of inhibition measuring 34.30 mm at 1024 ppm. In comparison, the standard drug Streptocyclin Sulphate demonstrated a zone of inhibition of 23.60 mm. These findings suggest that plant-mediated synthesis of nanoparticles is a promising strategy for developing versatile, eco-friendly agricultural products.

HETEROSIS ESTIMATION IN PAPAYA PROGENIES DERIVED FROM LINE × TESTER MATING DESIGN FOR KEY AGRONOMIC TRAITS

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Abstract

Heterosis, a term introduced by Shull in 1914, refers to the superiority of F1 hybrids over their parents, signifying improved fitness and vigor. In papaya breeding, notable crosses demonstrated significant heterosis for key traits. Early flowering is a desirable trait, with crosses like AC-119 × Co-4 and Dwarf Lily × Co-4 exhibiting the highest negative heterobeltiosis (-14.03% and -14.33%, respectively), highlighting their potential for developing early-maturing hybrids. Plant height reduction, advantageous for management, was evident in hybrids such as Line-21 × Coorg Honeydew (-35.81%) and Pant Papaya-2 × Coorg Honeydew (-30.62%). These crosses are promising for creating compact plant varieties. Increased leaf number enhances photosynthetic efficiency, with hybrids like 4 × 1 (20.69%) and 6 × 1 (30.43%) showing significant positive heterobeltiosis. Similarly, robust stem girth, essential for plant strength, was observed in crosses like Washington × Lucknow (13.92%) and Pant Papaya-2 × Co-4 (5.38%). The number of fruits per plant, a critical yield-related trait, showed marked heterobeltiosis in hybrids such as Arka Prabhat × Coorg Honeydew (48.81%) and AC-119 × Lucknow (37.39%). Additional traits like fruit weight, diameter, length, pulp thickness, and total soluble solids also demonstrated significant heterosis in select crosses, underscoring their superiority over parents and commercial checks. For instance, Red Indian × Lucknow exhibited high heterobeltiosis for fruit weight (48.72%). Collectively, these results underscore the potential of specific crosses in enhancing papaya breeding programs, emphasizing traits such as early flowering, reduced plant height, and improved fruit characteristics for greater agronomic and commercial success.

EFFECTIVE POST-HARVEST HANDLING STRATEGIES TO MINIMIZE LOSSES IN FRUITS AND VEGETABLES

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Abstract

Fruits and vegetables are highly perishable agricultural commodities, making proper harvesting crucial for preserving their quality and extending storage life. Harvesting fruits at inappropriate stages—whether under- or over-mature—leads to reduced shelf life and quality degradation. Vegetables, on the other hand, are often harvested at their horticultural maturity. However, poor post-harvest handling practices significantly contribute to substantial losses, both economically and in terms of produce. The absence of appropriate handling techniques and inadequate use of chemical treatments exacerbates the loss of these commodities. Consequently, producers face severe economic setbacks due to improper handling, lack of understanding about the causes of post-harvest losses, and insufficient preservation methods. Implementing proper post-harvest management strategies, including cleaning, grading, sorting, and adopting suitable storage and transportation methods, can significantly reduce these losses. Additionally, pre-harvest and post-harvest chemical treatments can help prolong shelf life by preventing contamination and mitigating the impact of harmful pathogens. This paper consolidates data from various credible sources to highlight effective post-harvest handling techniques for fruits and vegetables, aiming to minimize losses and enhance produce availability.



INFLUENCE OF WALNUT (*JUGLANS REGIA*) LEAF EXTRACT ON THE GERMINATION AND GROWTH OF CABBAGE (*BRASSICA OLERACEA CAPITATA*) IN HORTI-SILVICULTURAL PRACTICES

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Abstract

The effect of varying doses of aqueous walnut leaves extracts on the the growth of seedlings and germination on cabbage (cv. Varun), which was suggested for the West Himalaya horti-silvicultural system, was investigated in an experiment. The concentrations of leaf extract in the treatments were 15%, 30%, 45%, 60%, and 75%, with distilled water serving as a control at 0%. The findings demonstrated a concentration-dependent inhibitory impact, whereby higher leaf extract concentrations resulted in less seed germination and seedling development. Significant phytotoxicity was seen at the maximum concentration (75%), which led to reductions in fresh and dry weight, vigour indices I and II, root and shoot lengths, and germination rates when compared to the control.

EFFECT OF COW URINE AND VERMIWASH DURING RAINY SEASON ON TOMATO STEM CUTTINGS

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Abstract

The investigation was carried out during 2022-23 at the Hi-Tech Unit, RCA, Udaipur. The experiment consisted of 10 treatments including different concentrations of cow urine and vermiwash replicated three times in CRD layout during the month of July-August. Observations were taken at 15 and 30 days after planting (DAP) of cuttings in pro-trays filled with sole cocopeat as media. Maximum shoot growth at 15 DAP observed i.e., number of leaves at cow urine 15%, shoot length at cow urine 5%, shoot diameter at cow urine 15% and vermiwash 10%. Maximum shoot growth at 30 DAP i.e., number of leaves at cow urine 15%, shoot length at cow urine 5%, shoot diameter at cow urine 15% and fresh weight of cutting at cow urine 5% and 10%. The majority of root parameters i.e., number of roots per cutting, length of root, fresh and dry weight of roots, root volume, survival percentage and chlorophyll content influenced by cow urine 5% and 10%. Tomato cutting propagated using various treatments where cow urine outperformed vermiwash in overall results.

ECONOMIC ENHANCEMENT OF GOAT FARMER BY ADOPTING THE CONTROLLED BREEDING AND ARTIFICIAL INSEMINATION IN GOAT

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Abstract

Goat population has been decreased (4.25 %) from 18th (2007) to 20th (2019) livestock census in Andaman and Nicobar Islands. This is due to intensive inbreeding, poor breeding & nutritional management, lack of elite breeding bucks, etc. This leads to loss of production and reproduction performances and economic loss to the farmers. These limitations would be overcome by selection of bucks, semen collection, and artificial insemination in goats. In addition, estrus synchronization improves management of goat farm, reduces the labour cost, enhances fertility rate and improves the economic benefit of the farmer. Animal's general and reproductive health are improved with use of package of practice (macrocytic lactone injection, phosphorus injection, mineral mixture supplement and germinated Bengal gram) for a period of one month. Followed by



estrus synchronization with hormone (Prostaglandin). The health status was improved in 90% of treated goats and heat expression response was 81.45%. These heat expressed goats were inseminated with quality checked semen. Conception rate was recorded as 50.35%. The kids borne through controlled breeding and artificial insemination with use package of practices had higher birth weight, weight gain, growth rate and twinning rate as compared to those kids borne to mother without any treatment with use of local common buck for natural breeding in field. Kidding interval was lower in treated goats with insemination of semen from elite bucks as compared to those non-treated goats with use of local common buck for natural breeding in field. Thus, the goat farmers were getting higher revenue with utilizing this package practices and following the scientific managerial practices especially controlled breeding and artificial insemination in goat. Therefore, the controlled breeding and artificial insemination practices improved the economic status of the goat farmers.

EFFECT OF VARIOUS INTERCROPS ON INCIDENCE OF *L. ERYSIMI* ON CABBAGE

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Abstract

The field trial was carried out in Rabi, 2021-22 season at Horticulture Farm, S.K.N. College of Agriculture, Jobner, investigation entitled “Effect of various intercrops on incidence of aphid *L. erysimi* on cabbage” An effort has been made to study the influence of intercrops on the incidence of Aphid infesting cabbage during Rabi, 2021-22. There were four intercrop combinations, viz., tomato, mustard, marigold and onion along with sole crop (cabbage). The infestation of aphid was started in the third week of December. Initially, the mean aphid population ranged from 61.25 to 90.11 aphid/ plant. The minimum population of aphid was found on cabbage + onion (61.25 aphid/plant) followed by cabbage + tomato (66.92 aphid/plant) intercrop combinations which was found significant different with each other. The maximum infestation was observed on sole crop (90.11 aphid/plant) followed by cabbage + mustard (85.92 aphid/ plant) and cabbage + marigold (77.82 aphid/plant) intercrop combinations and these were found statistically significant with each other (except cabbage + marigold). The infestation of aphid increased gradually and reached to peak in the second week of February and mean aphid population ranged from 119.87-142.50 per plant. The minimum population of aphid was observed on cabbage + onion (119.87 aphid/ plant) followed by cabbage + tomato (128.33 aphid/plant) intercrop combinations and the maximum population of aphid was recorded on sole crop (142.50 aphid/ plant) followed by cabbage + mustard (139.49 aphid/ plant) and cabbage + marigold (136.42 aphid/ plant). The mean aphid population during the season ranged from 79.75-111.15 per plant. The overall mean population of aphid was found minimum in the cabbage + onion (79.75 aphid/ plant) followed by cabbage + tomato (90.51 aphid/ plant), cabbage + marigold (97.02 aphid/ plant) and cabbage + mustard (102.21 aphid/ plant) intercrop combination and the maximum on sole crop (111.15 aphid/ plant). Therefore, an overall view of mean incidence of aphid, *L. erysimi* on cabbage and different intercrop combination showed a definite effect on the pest incidence. A striking reduction in the population of aphid was noticed in cabbage + onion and cabbage + tomato intercrop combinations.

EFFECT OF CINNAMON BARK OIL ON SCROTAL CIRCUMFERENCE, TESTICULAR WEIGHT, HORMONE LEVELS, LIBIDO, ANTIOXIDANTS AND SEMEN QUALITY IN TERESSA GOAT BUCK

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Abstract

The Nicobar area of the Andaman and Nicobar Islands in India is home to the unique Teresa goat breed. Cinnamon (*Cinnamomum zeylanicum*) bark oil (CBO) was studied in Teresa goat bucks during the rainy and dry summer seasons for its effects on body weight (BW), scrotal circumference (SC), testicular volume (TV), testicular weight (TW), hormones, libido, antioxidants, and semen quality profiles (SQPs). Twenty-four (n=24) Teresa bucks aged between 3-4 years were divided evenly into control (Gr 1) and treatment (Gr 2: 0.50 mL/head/day, Gr 3: 1.00 mL/head/day and Gr 4: 2.00 mL/head/day) groups. Various parameters including BW, SC, TV, TW, blood follicle-stimulating hormone (FSH), luteinizing hormone (LH), testosterone, thyroid stimulating hormone (TSH), triiodo thyronine (T3), thyroxine (T4), cortisol and prolactin, total



antioxidant capacity (TAC), superoxide dismutase (SOD), catalase (CAT), glutathione (GSH), malondialdehyde (MDA) concentration, libido score (LS), mating ability score (MAS), sex behavioral score (SBS), and SQPs were assessed in both the CBO treated and control groups of bucks across the rainy and dry summer seasons. The results indicated that in bucks supplemented with cinnamon bark oil, there were significant increases ($P < 0.05$) in parameters such as BW, SC, TV, TW, FSH, LH, testosterone, TSH, T3, T4 and antioxidants, while cortisol, prolactin, and MDA levels were significantly lower ($P < 0.05$) compared to the control group. Additionally, parameters such as semen volume, pH, sperm concentration, mass activity, total motility (TM), viability, acrosomal integrity (AcI), plasma membrane integrity (PMI) and nuclear integrity (NI) were significantly higher ($P < 0.05$) and total sperm abnormality (TSA) was significantly lower ($P < 0.05$) in bucks treated with CBO compared to those in the control group. The findings of present study showed that cinnamon bark oil improved the semen quality profiles of Teressa goat bucks raised in the humid tropical island ecosystem of the Andaman and Nicobar Islands by having a beneficial effect on hormone levels, libido, antioxidants, and scrotal and testicular parameters.

SUSTAINABLE AGRICULTURE PRACTICES AND THEIR MANAGEMENT

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Abstract

Sustainable agriculture practices can help mitigate the impacts of climate change, improve crop resilience, and ensure long term food security. However, sustainable agriculture often requires more manual labor than conventional agriculture, which can increase production costs and reduce profitability. Sustainable agriculture practices include: Crop rotation, Cover crops, Integrated pest management (IPM), Reduced or eliminated tillage, Drip irrigation, compost, small-scale agriculture and Biogas production, crop waste recycling, polyculture, crop residue management, biodynamic, organic farming and agroforestry etc. Sustainable agriculture insists on moderate consumption of non-renewable resources, with nature and future generations in mind. The approach advocates switching to renewable energy sources, sparing land use, and eliminating nature pollution. Farmers seek successful management solutions and the remote sensing technology in sustainable agriculture provides data for the most accurate and reliable analytics. They are set of practices that aims to produce food while also preserving the environment and the well-being of farmers and local communities.

EFFECT OF DIFFERENT LOADS AND AGES OF INOCULUM ON DISEASE DEVELOPMENT OF WEB BLIGHT OF MUNGBEAN

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Abstract

Among pulses mungbean [*Vigna radiata* (L.) Wilczek] which was originated in South and South East Asia and belonging to the family leguminosae (Wilczek, 1954) (now Fabaceae), is one of the most important pulse crops of the country. It is grown in Kharif, spring and summer seasons. Mungbean also referred as green gram, moong, mung, golden gram or sona is mainly grown for its highly proteinacious and easily digestible seeds that are used for human consumption. Effect of different ages and loads of inoculum on web blight that 10 days old culture applied at the rate of 10, 20 and 30 g in each pot was found significantly superior in causing the highest disease intensity of 41.22, 57.25 and 59.75 per cent, respectively followed by 5 days old culture with same doses (10, 20 and 30 g) produced disease intensity of 40.88, 56.50 and 58.25 per cent followed by 15 days old culture with same doses (10, 20 and 30 g) produced disease intensity of 38.22, 55.11 and 57.14 per cent, respectively. However, twenty days old culture was found least effective in disease development with 37.50, 54.75 and 56.00 per cent, respectively. The average disease intensity with all doses of inoculum varied from 39.45-57.78 per cent with different ages of inoculum. It was highest in the 30 g dose (57.78 per cent) followed by the 20 g dose (55.90%). The lowest average disease intensity (39.45%) was recorded for a 10 g dose. The inoculum doses of 20 and 30 g were sufficient to produce higher disease as compared to the 10 g dose. The average disease intensity with inoculum of different age varied from 49.41 to 52.74 per cent with different doses of inoculum. It was highest in the 10-day-old culture (52.74%) followed by 5 day 5-day-old culture (51.87%) and lowest average disease intensity in the 20- day-old culture (49.41%).



COMPARATIVE BIO-EFFICACY OF DIFFERENT TREATMENTS AGAINST MAJOR INSECT PESTS IN PEARL MILLET

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Abstract

The research experiment was conducted for the management of shoot fly, *Atherigona approximata* and ear head worm, *Helicoverpa armigera* in pearl millet at Research Farm, Agricultural Research Station, Mandor during Kharif 2022. The results showed that the plots treated with treatment T₁ (seed treatment with imidacloprid 600 FS @ 8.75 ml/kg + spray of imidacloprid 17.8 SL @ 0.5 ml/l at vegetative stage + emamectin benzoate 5 SG @ 3 g/10 l at ear head stage) followed by treatment T₂ (seed treatment with imidacloprid 600 FS @ 8.75 ml/kg + spray of imidacloprid 17.8 SL @ 0.5 ml/l at vegetative stage + chlorantraniliprole 18.5 SC @ 3 ml/10 l at ear head stage) and T₃ (seed treatment with imidacloprid 600 FS @ 8.75 ml/kg + spray of imidacloprid 17.8 SL @ 0.5 ml/l at vegetative stage + indoxacarb 14.5 SC @ 0.5 ml/l at ear head stage) were found most effective against shoot fly and ear head worm. The maximum grain yield was recorded in the plots treated with treatment T₁ (3042 kg/ha) followed by treatment T₂ and T₃ (3000 and 2937 kg/ha, respectively). The highest benefit cost ratio (3.77:1) was obtained in plots treated with treatment T₁ followed by treatment T₃ and T₂ (3.58:1 and 3.43:1, respectively).

REMOTE SENSING APPLICATIONS FOR SMARTER AGRICULTURAL PRACTICES

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Abstract

Remote sensing offers numerous advantages in agronomical research. The assessment of crop canopies through this technology provides valuable insights into key agronomic parameters. It plays a pivotal role in crop classification, monitoring and yield estimation. The use of remote sensing is essential in agronomic studies due to the high sensitivity of crops to variations in soil, climate and other physico-chemical factors. Agricultural production systems exhibit strong seasonal patterns linked to the biological life cycle of crops and these factors vary significantly across both spatial and temporal dimensions. Agricultural productivity can shift rapidly under adverse growing conditions, necessitating timely monitoring. Remote sensing provides accurate and frequent updates, making it an indispensable tool for monitoring agricultural systems effectively. Sustainable agricultural management requires a comprehensive spatiotemporal analysis of all factors impacting the sector. When integrated with advanced technologies like Global Positioning Systems (GPS) and Geographic Information Systems (GIS), remote sensing enhances the evaluation and management of agricultural activities. These technologies find diverse applications, including crop acreage estimation, growth monitoring, soil moisture and fertility evaluation, detection of crop stress, diseases and pest infestations, as well as monitoring extreme conditions like droughts and floods. They also aid in yield prediction, weather forecasting and precision agriculture, all of which contribute to the sustainability of agricultural systems and bolster the country's economic growth.

CLIMATE CHANGE EFFECT IN TURMERIC CULTIVATION IN THOUBAL DISTRICT OF MANIPUR

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Abstract

Agriculture is extremely vulnerable to climate change because it is one of the sectors hardest to hit by adverse climate conditions. In addition, as climate change is influencing turmeric and output of turmeric is declining. This research was carried out to study the observed climate change effects in turmeric by the sample turmeric farmers on climate change. Data for the



study were collected from 111 turmeric growing farmers of Thoubal District of Manipur through personal interview. The total research sampling was done purposively. The changes in climatic variables have visible impacts on turmeric crop such as decreased rhizome formation, decreased crop period etc. Majority of the farmers observed there is a decrease in around 25% of productivity in turmeric. In the meantime, farmers also observed that the decrease in rhizome formation has reduced the productivity of the turmeric by 35-45% and majority of the farmers witnessed the decrease in the life span of the crop due to climate change. Majority of the farmers felt that the diseases were due to climate change.

FIELD SCREENING OF SOYBEAN GENOTYPES AGAINST LEAF EATING CATERPILLARS IN SOYBEAN

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Abstract

Investigation was carried out at All India Co-ordinated Research Project (AICRP) on Soybean, Main Agricultural Research Station, University of Agricultural Sciences, Dharwad during *kharif* 2023 in randomized block design (RBD) with two replications. About 22 soybean genotypes obtained from AICRP on Soybean, Indore and AICRP on Soybean, UAS, Dharwad center were evaluated under field condition to find out their resistance against defoliators. Among the soybean genotypes screened for the resistance against defoliators including *Spodoptera litura* (Fab.), *Thysanoplusia orichalcea* (Fab.) and *Spilarctia obliqua* (Walk.) the genotype SL 1311 was found to be a superior over rest of genotypes with least per cent defoliation and categorized as highly resistant. It was followed by genotypes VLS 108 and AMS 2021-3 with comparatively least per cent defoliation and was classified as resistant. Moderately resistant genotypes included Himso 1696, DSb 40, NRC 258 and AS 34. Genotypes KDS 1203, NRCSL 5, MACS 1756, JS 24-34, MAUS 824, KDS 1188 and Pusa Nipani 433 were categorized as least resistant. Genotypes NRC 257, RSC 1172, MAUS 814 and DSb 39 were classified as susceptible. Furthermore, the genotypes NRC 259, NRC 260, AMS 2021 and JS 335 showed the most severe levels of defoliation, leading to their classification as highly susceptible. Correlation studies revealed that biophysical traits such as thicker leaves and higher trichome density were linked to greater resistance and reducing rate of defoliation.

THE ROLE OF CULTURAL PRACTICES IN ENHANCING SOIL HEALTH AND MANAGING SOILBORNE PATHOGENS

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Abstract

Numerous cultural practices, such as utilizing cover crops, rotational cropping systems, composting and varied tillage methods, are promoted to enhance soil health and quality. These practices significantly influence soilborne pathogen populations and the severity of associated root diseases. Soil biology plays a crucial role in maintaining soil productivity and quality. Microbial activities within the soil include decomposing organic matter, nutrient mineralization, nitrogen fixation, pest suppression and root protection, as well as parasitic interactions that may harm plants. Therefore, it is vital to implement soil management strategies that not only improve soil quality but also foster healthy soil conditions. Healthy soils are characterized by diverse microbial populations, abundant beneficial organisms, and reduced levels of harmful pests. In vegetable and food crop production, soilborne pathogens often pose a major threat, necessitating effective control measures. Monitoring root disease incidence and severity can serve as an indirect indicator of soil health tailored to specific crops and soil systems. Thus, selecting and applying cultural practices that mitigate root diseases is crucial for sustainable soil management. Case studies highlight the role of cover crops and their green manures in managing nematodes, such as root-knot and lesion species, and demonstrate how practices like tillage, soil amendments, crop rotation and cover cropping influence bean yields and root rot severity.



EFFICACY OF CYCLOBUTRIFLURAM 50% W/V FS AGAINST SEEDLING OR COLLAR ROT (*ASPERGILLUS* SPP.) OF GROUNDNUT

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Abstract

Groundnut (*Arachis hypogea* L.) is one of the most important oilseed crops. Groundnut production is threatened by a large number of diseases caused by various plant pathogens viz.- fungi, bacteria, virus and phytoplasma. Seedling or Collar rot caused by *Aspergillus* spp. is a widespread, destructive disease. Considering the drastic incidence of this disease an experiment was carried out at instructional farm, Rajasthan College of Agriculture-Udaipur by using different doses of Cyclobutrifluram 50% w/v FS (0.5, 0.1, 0.2, 0.3 and 0.4g/kg) as seed treatment along with two checks Carboxin 37.5% + Thiram 37.5% WS and Carbendazim 25% + Mancozeb 50% WS. Among the different doses of Cyclobutrifluram 50% w/v FS, two checks and control plot Cyclobutrifluram 50% w/v FS doses 0.1 to 0.3 g ai / kg seed was found to be optimum dose for effective management of the groundnut seedling or Collar rot. Cyclobutrifluram 50% w/v FS 0.3 g ai / kg seed treatment showed lowest 3.49% and 4.32% disease incidence and higher 15.54 and 14.85 q/ha yield of groundnut over control and checks in 2021 and 2022 respectively.

EFFECT OF NEWER NEMATICIDE ON ROOT-KNOT NEMATODE (*MELOIDOGYNE JAVANICA*) IN FIELD PEA

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Abstract

The research trial experiment was conducted during Rabi Season-2021-22 in the root-knot nematode sick field at Rajasthan Agricultural Research Institute, Durgapura, Jaipur Rajasthan on field pea (*Pisum sativum* Var. *arvens* L.). In this research trial application of different doses of newer nematicide i.e., fluensulfone 2% GR were applied at the time of sowing. In this experiment total number of treatments were eight i.e., T₁- 8 kg/ha., T₂- 10 kg/ha., T₃- 12 kg/ha., T₄- 14 kg/ha., T₅- 16 kg/ha., T₆- 18 kg/ha., with carbofuran 3G was taken as a chemical check at the dose of 50 kg/ha. in T₇ and untreated check also maintain as control (T₈) for comparison. All the treatments were replicated three times with statistical design RBD. Result findings of this research trial fluensulfone 2% GR 18 kg/ha. in treatment six was found best for the management of root-knot nematode with the excellent plant growth parameters i.e., shoot length (268.66 cm), root length (21.16 cm), shoot weight (412.66 gm), root weight (9.00 gm), no. of *Rhizobium* nodules per plant (31.33/plant), average plant population per plot at harvest (412.33/plot) and yield (23.23 Qtls./ha.) and minimum nematode reproduction parameters i.e. number of galls per plant (6.33), number of egg masses per plant (3.66), number of egg and larvae per egg mass (190.00), nematode population per 200 cc soil (107.00) and final nematode population (805.00). Significantly improved yield of field pea and reduction in nematode reproductive parameters was observed.

MANAGEMENT OF BLAST DISEASE OF PEARL MILLET THROUGH NOVEL COMBINED FORMULATIONS OF FUNGICIDES

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Abstract

The experiment was carried out during at Agricultural Research Station, Keshwana, Jalore is functioning under the jurisdiction of Agriculture University, Jodhpur. Seven different fungicides were evaluated for the management of Blast



disease of Pearl millet through spraying twice at 15 days intervals under field conditions. The results showed that the per cent disease intensity revealed that all the fungicides significantly effectively reduced the Blast disease of Pearl millet disease over control. The minimum disease intensity (6.25 %) was recorded with the application of Propiconazole 25% SC @ 0.1 % (1ml/l) with 84.43 per cent decreased disease intensity. However, Tebuconazole 50% + Trifloxystrobin 25 % WG @ 0.04% (0.4g/l) were observed to be second best with 7.28 per cent disease intensity with 81.16 per cent decreased intensity. Carbendazim 12% WP + Mancozeb 63% @ 0.25% (2.5g/l) was found least effective with 24.20 per cent disease intensity and 39.72 per cent decreased intensity. The maximum yield (1860 kg/ha) was recorded in Propiconazole 25% SC @ 0.1 % (1ml/l) followed by Tebuconazole 50% + Trifloxystrobin 25 % WG @ 0.04% (0.4g/l) with 1748 kg /ha and, respectively. Least yield was obtained with Carbendazim 12% WP+ Mancozeb 63% @ 0.25% (2.5g/l) (1350 kg/ha).

EFFECT OF FERTIGATION AND IRRIGATION LEVELS ON YIELD AND ECONOMICS OF *RABI* CHILLI (*CAPSICUM ANNUM L.*) UNDER MULCH AND NO MULCH CONDITIONS OF SOUTHERN TELANGANA

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Abstract

An experiment was conducted on *rabi* chilli at Water Technology Center fields, College Farm, PJTSAU, Hyderabad, Telangana. The experiment consisted of 12 treatment combinations of three fertigation levels (75 % RDF, 100 % RDF & 125 % RDF), two drip irrigation levels (0.8 Epan & 1.0 Epan) imposed under factorial combination of with silver black plastic mulch (30µ) (M₁) and no mulch (M₀) conditions during 2020-21 and 2021-22. Application of drip fertigation levels and mulch had significant effect on total fresh fruit yield as well as net monetary returns of the chilli and these parameters did not significantly influenced by drip irrigation levels during both the years of the study. The results revealed that application of 100 % RDF (300-60-120 kg N-P₂O₅-K₂O) recorded the highest fresh fruit yield (30.98, 31.32 & 31.15 t ha⁻¹, respectively). Similarly, the higher net returns (?. 7,69,453 /-, 10,69,525 /- & 9,19,489 /- ha⁻¹, respectively) were observed with B:C ratio ((4.81, 5.84 & 5.33, respectively). Mulching of the crop has recorded the maximum fresh fruit yield of chilli (36.21, 38.90 & 37.56 t ha⁻¹, respectively), net returns (?. 9,14,175, 13,54,489 & 11,34,332 ha⁻¹, respectively) and B:C ratio (5.31, 6.72 & 6.07, respectively) during 2020-21, 2021-22 and in pooled data. The interaction effect of fertigation levels, irrigation levels and mulch found to be non- significant during both the years.

ADVANCES IN DISEASE AND PEST MANAGEMENT

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Abstract

Recent advancements in disease and pest management have transformed agriculture, promoting sustainable practices while addressing environmental and economic challenges. Integrated Pest Management (IPM) has emerged as a cornerstone strategy, combining biological control, cultural practices, and targeted chemical use to reduce pest damage, minimize resistance, and limit ecological impact. Biotechnological tools like CRISPR-Cas9 and genetic engineering have accelerated the development of pest- and disease-resistant crops, while high-throughput sequencing and bioinformatics enable early detection and precise identification of pathogens, enhancing surveillance and tailored interventions. Eco-friendly biological



control agents, such as beneficial microbes, entomopathogenic fungi, and microbial consortia, provide alternatives to synthetic pesticides, suppressing pests while improving plant immunity and soil health. Nanotechnology has introduced precision delivery systems for agrochemicals and biological agents, improving efficiency and reducing environmental harm. Simultaneously, digital technologies, including drones, remote sensing, and artificial intelligence, revolutionize pest and disease monitoring, offering real-time data and predictive models for proactive, targeted management. Big data analytics further supports adaptive strategies to cope with evolving pest dynamics and environmental changes. Amid climate change, shifting pest patterns, and growing food demand, these innovations highlight the importance of sustainable, science-driven solutions. Collaboration among researchers, policymakers, and farmers is critical to implement effective pest and disease management strategies, ensuring global food security and ecological resilience. Together, these advancements pave the way for more resilient and sustainable agricultural systems.

PRECISION AGRICULTURE APPLICATIONS IN HORTICULTURAL CROPS

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Abstract

Precision agriculture (PA) represents a transformative approach to horticultural crop management by integrating advanced technologies and data-driven practices. This method enhances productivity, resource efficiency, and environmental sustainability. Key applications of PA in horticulture include site-specific soil and crop management, precision irrigation, automated planting and harvesting, and pest and disease monitoring. Technologies such as Geographic Information Systems (GIS), remote sensing, drones, and Internet of Things (IoT) devices enable real-time monitoring and decision-making. PA ensures optimal input usage, including fertilizers, water, and pesticides, reducing waste and cost while improving yield quality. Challenges include high initial investment, technical complexity, and data integration issues. However, with the increasing adoption of artificial intelligence (AI) and machine learning (ML) for predictive analytics and robotics for automation, PA holds immense potential to revolutionize horticultural practices. The adoption of PA practices in horticultural crops will ensure sustainable intensification, meeting the dual goals of productivity and environmental conservation.

BREEDING FOR BIOTIC AND ABIOTIC STRESS RESISTANCE/TOLERANCE IN PEARL MILLET

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Abstract

Pearl millet [*Pennisetum glaucum* (L.) R. Br.] is a resilient and vital crop, particularly in arid and semi-arid regions of Africa and Asia, known for its adaptability to harsh environmental conditions. This study focuses on the breeding strategies aimed at enhancing resistance and tolerance to both biotic (pests and diseases) and abiotic (drought, salinity, and temperature extremes) stresses in pearl millet. Biotic stress factors such as the downy mildew (*Sclerospora graminicola*) and stem borer (*Coniesta ignefusalis*) significantly affect yield, necessitating the incorporation of resistant varieties into breeding programs. Marker-assisted selection (MAS) and genomic tools have been employed to identify and integrate resistance genes into elite breeding lines. By leveraging both traditional breeding methods and modern genomic techniques, we aim to develop pearl millet varieties with enhanced resistance profiles. On the abiotic stress front, pearl millet's inherent drought tolerance and ability to thrive in low-nutrient soils position it as a promising candidate for climate-resilient agriculture. Breeding initiatives focus on traits such as root depth, water use efficiency, and adaptive phenological characteristics. Through the use of quantitative trait loci (QTL) mapping and genome-wide association studies (GWAS), we are identifying key genetic determinants associated with abiotic stress resilience. Researchers emphasize an integrated breeding approach that combines traditional selection with cutting-edge biotechnological advancements. Field trials and multi-environment assessments are critical to validate the performance of newly developed varieties under varying stress conditions. The ultimate goal is to produce pearl millet cultivars that not only enhance food security but also contribute to sustainable agricultural practices in the face of climate change. By fostering collaboration among breeders, agronomists, and geneticists, it can accelerate the development of improved pearl millet varieties, ensuring their viability and productivity in challenging environments.



PRECISION FARMING: A SUSTAINABLE APPROACH FOR ADVANCING HORTICULTURE

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Abstract

Precision farming is an advanced, technology-driven approach aimed at optimizing agricultural and horticultural productivity while promoting sustainability and environmental conservation. It incorporates a range of modern technologies and management strategies to analyze and control variability within fields. This system emphasizes the use of crop-related data, advanced equipment and precise management practices throughout the production process, from crop planning to post-harvest handling. Key technologies include Global Positioning Systems (GPS), Geographic Information Systems (GIS), sensors, remote sensing and specialized software, which facilitate site-specific applications of water, fertilizers and pesticides. Despite its potential, the adoption of precision farming in India is constrained by factors such as small landholdings, limited awareness, inadequate government policies and insufficient extension programs. Over 60% of Indian farmers operate on less than one hectare of land, making the implementation of such technologies challenging. However, cooperative farming and targeted applications in high-value horticultural crops present significant opportunities. Precision farming addresses crucial aspects like nutrient deficiencies, pest control, soil health and water management, thereby contributing to increased productivity, economic efficiency and reduced environmental impacts. Globally, advanced countries leverage precision farming technologies to meet food production demands without expanding arable land, ensuring ecological balance and high-quality output. In contrast, India must overcome its constraints to harness the benefits of these technologies for meeting the demands of its growing population. Precision farming is indispensable for future agricultural and horticultural systems, ensuring sustainable production and enhancing the nation's food security and economic prosperity. It is not only a necessity for addressing the challenges of limited land resources but also a cornerstone for achieving the dual goals of quantity and quality in crop production.

FOOD PROCESSING AND VALUE ADDITION FOR AUGMENTING FARMERS INCOME

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Abstract

The agricultural sector serves as a cornerstone of the economy in many nations, yet farmers often face low incomes due to fluctuating commodity prices, post-harvest losses and limited market access. Food processing and value addition emerge as transformative strategies to address these challenges and enhance farmers' earnings. By converting raw agricultural produce into market-led products, food processing not only increases shelf life but also adds economic value, creating employment opportunities for better income distribution across the supply chain. Value addition involves activities such as cleaning, grading, packaging and transforming produce into higher-value products like jams, juices, pickles or other processed cereals. These interventions cater to evolving consumer preferences for convenience and quality while reducing post-harvest wastage, which accounts for a significant loss in agricultural value. For example, turning tomatoes into puree or mangoes into dried slices enables farmers to command higher prices than selling raw produce. Government policies and initiatives play a pivotal role in promoting food processing and value addition. Schemes like the Mission for Integrated Development of Horticulture (MIDH) and Pradhan Mantri Kisan Sampada Yojana in India provide infrastructure, training and financial support to Small and Medium Enterprises (SMEs) and farmers. Encouraging Farmer-Producer Organizations (FPOs) to adopt agro-processing technologies and establishing cold storage and logistics networks further strengthen these efforts. Moreover, food processing fosters rural employment, diversifies income sources and enables farmers to tap into domestic and export markets. However, challenges such as inadequate infrastructure, lack of technical knowledge and market linkage barriers need urgent attention. Embracing modern technologies like artificial intelligence, blockchain for traceability and e-commerce platforms can bridge these gaps. This paper suggests that food processing and value addition are the sustainable pathways to increase farmers' incomes, mitigating post-harvest losses and address market volatility. At the same time, a holistic approach encompassing technology, policy support and capacity-building can also empower farmers to transform them from mere producers to active participants in the agri-value chain, fostering rural economic growth and ensuring food security. This change is essential for creating a resilient agricultural sector that benefits both producers as well as consumers.



ROOT ROT DISEASE OF MULBERRY IN KOPPAL DISTRICT OF KARNATAKA

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Abstract

The mulberry root rot disease is more because of intense cultivation, loss of plant vigor and increased susceptibility to soil-borne pathogens. The disease was caused by fungal complex and the severity was influenced by micro and macro climatic factors. Survey was undertaken during 2022-23 in Koppal district of Karnataka to know the status of dry root rot of Mulberry. This disease occurs throughout the year. The symptoms in the field were progressive wilting, premature drying, loss of vigor and yield reduction in mulberry plants. The surveyed data revealed that incidence of dry root rot ranged from 1.00 to 23.00 per cent with mean average incidence of 6.90 per cent. The highest disease incidence was noticed in Yelburga taluk followed by Kukanoor taluk with the incidence ranged from 3.00 to 19.00 per cent and 2.00 to 17.00 per cent, respectively with mean incidence of 9.00 per cent and 8.50 per cent, respectively. Among the varieties cultivated V₁, S₃, S₁₃, S₃₀, S₃₄, S₃₆, S₅₄ and local variety were showed the disease incidence with moderate to severe symptoms of dry root rot disease. The performance of V₁ mulberry was very good for tree type cultivation, but, showed higher root rot of 23.00 per cent. The V₁ and S₃₆ mulberry varieties were more susceptible and more prone to root rot disease and showing higher disease incidence. The shoot harvested portion of the plant was showing more susceptibility to the pathogen. The recorded data showed higher root rot incidence in all the varieties which were cultivated under the low water situation with the low moisture and soil cracking situations. Among farmers, few following the soil application of FYM + *Trichoderma* with cultivating methi, coriander in mulberry rows and also the mixed cropping systems in such fields the incidence of root rot was minimum.

HARNESSING INDIGENOUS TECHNICAL KNOWLEDGE FOR RESILIENT AND SUSTAINABLE AGRICULTURE

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Abstract

Indigenous Technical Knowledge (ITK) plays a critical role in advancing sustainable crop production by offering eco-friendly, low-cost, and resource-efficient farming practices that have evolved over generations. ITK encompasses traditional agricultural knowledge, soil management techniques, water conservation methods, pest control practices, and crop diversity strategies adapted to local climates and ecosystems. This body of knowledge is uniquely suited to address the challenges of modern agriculture, particularly in the face of climate change, biodiversity loss, and declining soil health. For instance, India's use of traditional water conservation methods like "johads" (small earthen dams) in Rajasthan has helped farmers capture rainwater for irrigation, effectively combating drought. Another example is mixed cropping and crop rotation in Northeast India, farmers in states like Manipur and Nagaland practice traditional shifting cultivation (jhum) with diverse crop combinations. This ITK method supports soil fertility through natural nutrient recycling, minimizes pest outbreaks, and maintains ecosystem health. As ITK is derived from generations of practical experience, it fosters resilience in agricultural systems by promoting biodiversity, preserving local crop varieties, and protecting soil fertility. Furthermore, ITK is crucial for food security and income stability in rural communities, as it reduces dependency on costly, external inputs like synthetic fertilizers and pesticides. It also enables farmers to adapt to environmental challenges by leveraging local resources. While ITK is locally rooted, its principles are widely applicable, offering global insights into sustainable agricultural practices. Integrating ITK with scientific research can enhance productivity without environmental degradation, making it a valuable asset for achieving global sustainability goals. Preserving and promoting ITK not only protects cultural heritage but also offers viable solutions for building resilient agricultural systems in the face of global environmental challenges.



SUSTAINABLE AGRICULTURE: NEW VISION FOR GLOBAL FUTURE'S FARMERS

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Abstract

Globally, ~4.8 billion hectares (44%) of the land mass is used for agriculture while ~1.58 billion ha land is used for growing food crops such as wheat, rice, maize, potato, soybean etc. China, the United Nations, India, Russia, France, Mexico, Japan, Germany, and Turkey have the major status of global agricultural countries including 61 countries of 6 continents in which India has the most arable land in the world. Many studies found that developing countries have witnessed higher demands for grain food, whereas developed countries have higher demands for sugar due to their evolutionary lifestyle. The globe needs to create a new vision, strategy, and global policies to meet and fulfill the requirements of food through sustainable agriculture for an increased population. There is a need to talk about exchanging ideas, future technologies, inventions, income models, latitude-based science, farm computers, global agricultural growth, and policy coordination collaborating with international scientists and agricultural institutions. The strategies of sustainable agriculture must ensure that everyone has access to nutritious food, creating decent employment conditions and fair prices for farmers and other rural dwellers, engaging stakeholders across the food system, taking a comprehensive approach to improving food systems, rather than isolated interventions as well as conserving natural resources and reducing greenhouse gas emissions.

IN VITRO EVALUATION OF DIFFERENT DE-OILED CAKES FOR INHIBITING THE GROWTH OF *FUSARIUM OXYSPORUM* F. SP. *GLADOLI*.

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Abstract

Gladiolus (*Gladiolus hybrida* L.) is an herbaceous perennial and economically important bulbous flowering crop belongs to family Iridaceae, sub family Ixiodeae and order Iridales. Gladiolus is native to Tropical and Mediterranean region of South Africa and generally known as “Glad” or “sword lily” and cultivated many parts of the world for cut flowers . Owing to their different size, shades and excellent vase life, gladiolus has fourth position in area and production among the preferred cut flowers in the world. The various bulbous flowering plants provide glamour, perfection and colour. Gladiolus has top rank in the list of bulbous flowering plant and can rightly be called the “Queen of bulbous flower crops” . *In vitro* different de-oiled cakes were tested against *Fusarium oxysporum* f.sp *gladioli* . The results obtained revealed that mycelial growth inhibition of the test pathogen ranged from 90.00-37.08 per cent. Among the four de-oiled cakes tested Neem cake was the mean maximum inhibition 37.08 percent followed by Castor cake 44.94 percent and then Mahua cake that is 58.61 The minimum growth was recorded in Mustard cake that is 56.33 per cent.

GREEN SYNTHESIS AND ANTIBACTERIAL POTENTIAL OF ZINC OXIDE NANOPARTICLES AGAINST *XANTHOMONAS ORYZAE* PV. *ORYZAE*

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Abstract

Green synthesis of nanoparticles offers numerous advantages over conventional physico-chemical methods, including eco-friendliness, cost-effectiveness, and biocompatibility, with wide-ranging applications in Agriculture field. In the present study, zinc oxide (ZnO) nanoparticles (NPs) were synthesized using *Melia azedarach* leaf extract. Zinc nitrate hexahydrate (0.02 M) served as the precursor for ZnO NP synthesis in the prepared leaf extracts. The structural and optical properties of the ZnO NPs were analyzed using X-ray diffraction (XRD), Fourier transform infrared (FTIR) spectroscopy, scanning electron



microscopy (SEM), and ultraviolet-visible (UV-Vis) spectrophotometry. The antibacterial potential of the ZnO NPs was evaluated using the well diffusion method against *Xanthomonas oryzae* pv. *oryzae* (Xoo), based on the zone of inhibition. A color change in the reaction mixture from brown to yellowish indicated the formation of ZnO NPs. The UV-Vis absorption spectrum showed a peak at 313 nm, while the XRD pattern matched the Joint Committee on Powder Diffraction Standards (JCPDS) card for ZnO, confirming the presence of pure ZnO NPs. FTIR analysis further validated the involvement of bioactive functional groups in the reduction of bulk zinc nitrate to ZnO NPs. SEM imaging revealed the spherical morphology of the synthesized NPs, and transmission electron microscopy (TEM) indicated a size of 6.28 nm. The ZnO NPs synthesized using *M. azedarach* leaf extract exhibited significant antibacterial activity against Xoo, with the highest zone of inhibition measuring 34.30 mm at 1024 ppm. In comparison, the standard drug Streptocyclin Sulphate demonstrated a zone of inhibition of 23.60 mm. These findings suggest that plant-mediated synthesis of nanoparticles is a promising strategy for developing versatile, eco-friendly agricultural products.

NUTRITIONAL, ANTIOXIDANT AND ANTI-MICROBIAL PROPERTIES OF UNDERUTILIZED SPINE GOURDS

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Abstract

Spine gourd (*Momordica dioica* Roxb.) is a perennial climber of family Cucurbitaceae. this medicinally important and nutritionally rich vegetable is known by different names in local dialects like kankoda, meetha karela, kakrol, etc. Spine gourd is endowed with health benefits such as healing of burns, lowering blood sugar level in type 2 diabetes Miletus, reduce inflammation, lowers the risk of cancer and build immunity. The fruit has highest length of 4.6cm and least length of 2.3cm whereas the weight varies between 28.07g and 8.77g respectively. The diameter of the gourd was 2.3 to 3.3cm. The moisture content of fresh gourd was found to be 86.24%. Per 100 grams, spine gourd contains 19.38 g of crude protein, making it a good source of plant-based protein. The carbohydrate content was 47.92 g, accompanied by 21.30 g of crude fiber, which supports digestive health. It also has 4.70g of crude lipid, contributing healthy fats to the diet. Mineral-wise, spine gourd provides 33 mg of calcium, 42 mg of phosphorus, 1.51mg of sodium, 8.25 mg of potassium and 4.60 mg of iron, making it beneficial for bone health and overall mineral intake. Additionally, it contains 0.05 mg of thiamin, 0.18 mg of riboflavin and has a calorific value of 311.50 kcal. The DPPH free radical scavenging activity, the ethanolic extract has shown maximum inhibition (84.2%), followed by aqueous (74.8%), ethyl acetate (69.4%) and chloroform (59.7%) extract. On the other hand, in total antioxidant activity, the ethanol extract has shown 80.1% inhibition, followed by aqueous (71.9%), ethyl acetate (67.2%) and chloroform (53.2%) extracts due to presence of phenolics, flavonoids and amino acids. The secondary metabolites such as steroids, fatty acids in hexane extract and proteins, saponin glycosides and triterpenes in ethyl acetate soluble portion of methanolic extract were found to be effective mostly against *Salmonella typhi* and *Shigella dysenteriae* in the 100 to 500µg/ml concentrations.

INNOVATIVE STRATEGIES IN VEGETABLE SCIENCE: INTEGRATING PEST MANAGEMENT, SUSTAINABLE POST-HARVEST TECHNOLOGIES AND VALUE ADDITION TO ENHANCE FARMER INCOME

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Abstract

Vegetable production plays a pivotal role in global food security and farmer livelihoods, contributing to nearly 20% of total agricultural GDP worldwide. However, pest and disease outbreaks cause an estimated 20–40% loss in vegetable yields annually. Addressing these challenges through integrated pest and disease management (IPDM) strategies, combined with sustainable post-harvest and value-addition technologies, can significantly augment farmers' income and livelihoods. This



study focuses on implementing biocontrol agents like *Trichoderma harzianum* and *Bacillus subtilis* alongside pheromone traps and cultural practices to reduce the dependence on chemical pesticides, ensuring ecological and economic sustainability. The use of resistant cultivars, such as the Arka Rakshak tomato variety, has shown to mitigate losses by up to 30%. Furthermore, integrating precision agriculture tools, such as remote sensing for early pest detection, has increased pest control efficiency by 25%. Post-harvest technologies, including vacuum cooling and modified atmosphere packaging, reduce post-harvest losses, which account for 30% of total vegetable production globally. Value addition, such as dehydration of onions or production of minimally processed vegetables, can increase market value by up to 40%. For instance, the conversion of fresh tomatoes into puree and sauces yields a profit margin of 50–70% for smallholder farmers. This integrated approach demonstrates the potential to boost productivity, enhance quality, and generate additional income streams for farmers. Adoption of such strategies, supported by farmer training and policy interventions, is vital for achieving sustainable development goals and ensuring resilient farming systems.

EVALUATING GERMINATION AND QUALITY PARAMETERS FOR MUNGBEAN MICROGREENS

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Abstract

Microgreens are functional food have diverse nutritional value and health benefits that consumed as dietary supplements. They are generally young, nutrient-dense, leafy greens harvested within 7-21 days after germination. Microgreens are gaining popularity because of their texture, color, flavor and aroma, also they help to address the problems arising due to rapid urbanization. Microgreens can be grown from variety of seeds including: mustard, beetroot, wheat, cabbage, radish, mungbean, lentils, spinach, and lettuce. These crops have potential health benefits as they are rich in vitamins, minerals, and antioxidants when consumed in small quantities. In this study, diverse genotypes of mungbean were grown as microgreens and were harvested at 7th day after sowing. They were analysed for various parameters such as shoot length, fresh and dry weight, moisture percent, crude protein, total phenolic content and total antioxidant activity. Also, there was positive effect of seed priming on the germination of the seeds. The shoot length, phenolic content and antioxidant activity varied from 4 to 10 cm, 50 to 130 mg/100 g and 60-90 %. The aim of our study was to offer useful insights into the growth circumstances necessary to produce microgreens with the greatest nutrient and health benefits.

SULFUR APPLICATION UNDER IRON DEFICIENCY INDUCED DIFFERENTIAL EXPRESSION OF PGNAS2, PGNAATA AND PGDMAS GENES IN CONTRASTING PEARL MILLET GENOTYPES

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Abstract

This study aimed to investigate the effect of Sulfur application under Iron deficiency on the expression of genes PgNAS2, PgNAATA and PgDMAS in contrasting iron uptaking pearl millet genotypes (HHB-67 Improved, non-biofortified and HHB-299, Biofortified), grown under controlled hydroponic conditions, in plant growth chamber. Nutrient deficiencies treatments were provided at five leaf stage, where four treatments of combinations of iron and sulphur viz., Control (T₀) (-Fe -S), T₁ (+Fe -S), T₂ (-Fe +S), T₃ (+Fe +S), were given. Samples for qRT-PCR based differential gene expression analysis were collected at different time intervals upto 72 hours after giving the treatments. It was observed that shoot expression of all three genes was highest in seedlings under Fe deficient treatment T₂ (-Fe+S), whereas, lowest shoot expression in both genotypes was obtained under sufficient Fe supply either without S application i.e., T₁ (PgNAS2 and PgDMAS in genotype HHB-67 Improved) or with S application i.e., treatment T₃ (PgNAS2, PgNAATA and PgDMAS in genotype HHB 299 and PgNAATA in genotype HHB-67 Improved), at 24 and 48 hours after treatment. Similarly, root expression of all three genes was highest in seedlings with S application under Fe deficient treatment T₂ (-Fe+S), whereas, lowest root expression in both genotypes was obtained under sufficient Fe supply either without S application i.e., T₁ (PgNAS2 in genotype HHB-67 Improved, only at 48



hours) or with S application i.e., treatment T₃ (PgNAS2, PgNAATA and PgDMAS in genotype HHB 299 and PgNAATA, PgDMAS in genotype HHB-67 Improved), at 24 and 48 hours after treatment. PgNAS2, PgNAATA and PgDMAS gene expression was higher in shoots as compared to roots in both genotypes, whereas, after 24 and 48 hours of treatments. PgNAATA (and PgDMAS at 48 hours) expression was higher in roots of HHB-67 as compared to shoots. Higher expression in shoot might be attributed to its more active involvement in the translocation and homeostasis of metal ion. These data suggests that Sulphur availability elevate the Phytosiderophores synthesis gene expression in both genotypes of pearl millet and its effect are more prominent under Iron deficiency conditions.

SURVEY FOR STATUS OF ANTHRACNOSE DISEASE CAUSE BY *COLLETOTRICHUM LINDEMUTHIANUM* IN MAJOR MUNGBEAN GROWING AREA OF RAJASTHAN

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Abstract

Mungbean [*Vigna radiata* (L.) Wilczek] is the most significant and often advanced pulse crop, it is third most important multipurpose pulse crop in India after chickpea and pigeon pea Anthracnose caused by *Colletotrichum lindemuthianum* is one of the most important diseases in the mung bean. Seed infection is the major source of anthracnose transmission to the next crop generation and provides conditions which enable the fungus to survive unfavourable weather conditions. A roving survey to assess the intensity of Anthracnose of Mung bean was carried out at 60 location comprising five districts of Rajasthan state during *Kharif* season of 2022-23. The most extreme disease frequency was seen in plants at a flowering and podding stage. The overall mean disease intensity was observed to be 22.60%. Among the five district lowest anthracnose intensity was noticed in Sikar (17.88%) followed by Nagaur (18.90%), while highest anthracnose intensity was recorded in Jaipur district (28.93 %) followed by Ajmer (24.64 %) and Tonk (22.65%).

ROLE OF MODERN TECHNOLOGIES TO COMBAT ABIOTIC STRESS IN COTTON

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Abstract

Abiotic stress is an important factor that affects the normal growth and development of plants and crop yield. In order to reduce the impact of abiotic adversities on growth and development of cotton, the material basis of cotton resistance and its physiological functions are being studied at the molecular level, as evidenced by the recent research progress of osmoregulation-related genes, protein-acting genes, and transcription regulatory factor genes. The development of thermostable cotton cultivars is becoming more and more popular, so cotton breeders should explore all of their options, including using genome editing techniques to achieve desired features, creating superior cultivars through traditional breeding, and utilizing molecular markers and transgenic technologies. Enhancing tolerance to salt stress can be achieved using marker assisted selection combined with modern gene editing techniques, which can improve breeding strategies that defend and maintain the structure and function of cellular components. The SAMS Gene Family in Cotton reveals that GhSAMS2 may be used to specifically increase cotton plants' resistance to a variety of abiotic stresses. miRNAs could be an innovative genetic target to enhance plant tolerance to particular stresses. The use of artificial miRNAs, as well as overexpression and knockout/down of both miRNAs and their targets, will be the best techniques for determining the specific roles of individual miRNAs in response to environmental stresses. Advances in CRISPR/Cas genome editing enable efficient targeted modification in most crops, thus promising to accelerate crop improvement, in this we finally summarize the applications of genome editing for trait improvement, development of techniques for fine-tuning gene regulation, strategies for breeding virus resistance, and the use of high-throughput mutant libraries. The utilization of CRISPR/Cas technology allows for precise modifications in the cotton genome, enabling the development of cultivars with enhanced tolerance to various abiotic stresses such as drought, salinity, and extreme temperatures. So, we discussed the challenges and opportunities for precision plant breeding and its bright future in agriculture.



NEW FRONTIERS IN ARTIFICIAL INTELLIGENCE AND AGRICULTURE APPLICATIONS

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Abstract

Modern sensors are widely used in many different fields, including robotics, navigation, automation, remote sensing, underwater imaging, etc. In recent years, sensors that use sophisticated techniques like artificial intelligence (AI) have become increasingly important in the fields of smart agriculture and remote sensing. The Internet of Things (IoT), which has made various kinds of sensor-based equipment and gadgets available, has also produced highly helpful instruments in the field of agriculture. AI-enabled sensors function as smart sensors. In this paper, we have examined in detail the developments in smart sensors and the Internet of Things, which are used in remote sensing and agricultural applications like crop monitoring, harvesting and weeding robots, using drones, and evaluating weather and soil quality. By providing a thorough improvement in IoT, the focus can be placed on particular sensor types and sensor technologies that will aid, new scenario in remote sensing for their new investigations and applications in the area of agriculture. Recent developments in sensor technologies, data management, and data analytics, the agricultural community now has a number of options for remote sensing (RS) technologies and agriculture applications. However, the agricultural sector has not yet fully implemented Remote Sensing technologies and other applications due to knowledge gaps regarding their sufficiency, appropriateness, and techno-economic feasibilities. Remote Sensing technologies and agri-applications offer a diagnostic tool that can act as an early warning system, enabling the agricultural community to intervene early to counter potential problems before they spread widely and negatively impact crop productivity.

FARMERS' INCOME : TREND AND STRATEGIES FOR DOUBLING

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Abstract

The paper aims to analyze income growth patterns, diversification of income sources across different farm sizes and states, and assess the feasibility of doubling farmers' incomes within six years. It addresses the goal of doubling farmers' income by 2022, as highlighted in the Union Budget, using data from the 59th (2002-03) and 70th (2012-13) NSSO Situation Assessment Surveys. The findings indicate that nominal income doubling over 5-6 years is already occurring. However, doubling real incomes within six years is a challenging but achievable goal with the implementation of effective strategies. These strategies must be multi-faceted, focusing on increasing returns, reducing costs, and ensuring sustainable incomes while considering the depleting natural resource base. Reliable, periodic income data is essential for tracking progress. The income referenced in this paper is net of production costs.

EVALUATING EFFECT OF TILLAGE AND WEED MANAGEMENT PRACTICES ON DIFFERENT PARAMETER OF PEARL MILLET

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Abstract

Pearl millet (*Pennisetum glaucum*), an important cereal crop cultivated in arid and semi-arid regions, plays a crucial role in ensuring food security and livelihoods. However, its productivity is often constrained by inadequate tillage practices and



inefficient weed management. This study investigates the combined effects of different tillage systems and weed management practices on the growth, yield, and quality parameters of pearl millet. The results highlight that reduced tillage, when integrated with a comprehensive weed management strategy, enhances plant growth, grain yield, and nutrient content. Reduced soil disturbance improves soil moisture retention and organic matter, while integrated weed management effectively suppresses weed competition without over-reliance on chemical herbicides. For instance, studies have shown that integrated weed management reduces weed density by 60–70% compared to chemical control alone (Kumar & Ladha, 2011). Additionally, no-tillage practices have been linked to better soil health and increased grain protein content due to minimized erosion and nutrient loss. The findings emphasize the need for sustainable agronomic practices to optimize resource use efficiency and improve crop productivity in pearl millet farming systems. This research also underscores the importance of long-term studies on conservation tillage and integrated weed management to address emerging challenges in climate-resilient agriculture. Future work should focus on scaling these practices across diverse agro-climatic zones to maximize their benefits.

PERFORMANCE OF SOME ADVANCE DESI CHICKPEA GENOTYPES AGAINST POD BORER, (*HELICOVERPA ARMIGERA*) RESISTANCE

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Abstract

Helicoverpa armigera is the major constraint in the production of crop worldwide. Crop losses could reach up to 90% if pod borer population is not managed properly. *Helicoverpa armigera* causes serious damage to this crop during most critical stages of fruit development. Its larvae can be seen initially on leaves, then flowers, young shoots and finally on pods. They can feed on many pods before attaining maturity. Pod borer is one of the most important pests of crop that feeds on leaves and developing seeds. Integrate management of *Helicoverpa armigera* and the use of resistant varieties of chickpea have been recommended. The objective of this study was to screen advance chickpea genotypes for pod borer resistance under field conditions to secure high yield. Twenty two advance desi chickpea (*Cicer arietinum* L.) genotypes were evaluated along with check variety for resistance against chickpea pod borer, *Helicoverpa armigera* infestation in a field trial during 2023-24 at pulses Research Unit, Dr. PDKV, Akola. None of the tested genotypes showed complete resistance against pod borer after studying larval population and pod damage. Pod damage ranged from 0.51 to 21.42% among different genotypes and larval population range per plant showed 0.20 to 2.40. Comparison of resistance among the genotypes showed that AKG 1402, BDNG 797, BDNG 2020-, Phule Vikram, resistance against pod borer, with low larval population, low pod damage and high grain yield.

IMPACT OF LONG-TERM AGROFORESTRY SYSTEMS ON SOIL NUTRIENT STATUS AND SOIL CARBON SEQUESTRATION IN SEMI-ARID REGION OF RAJASTHAN

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Abstract

To explore the impact of different tree-based agroforestry systems on soil nutrient status and carbon sequestration, a long-term field trial was conducted under three tree-based agroforestry systems consisting of tree species, namely *Acacia tortilis*, *Hardwickia binata*, and *Tecomella undulata*, along with fallow land at Agriculture Research Station, Fatehpur, Sikar, Rajasthan. The soil samples were collected from four different soil depths (0-15, 15-30, 30-60 and 60-90 cm) with three replications and analyzed for soil available macro nutrients, micronutrients and soil carbon stocks. The findings showed that under all agroforestry systems, a higher soil available N, P, K and micronutrients was recorded as compared to fallow land at all soil depths. The *Acacia tortilis* based agroforestry system had higher soil organic carbon than other agroforestry systems and fallow land. The soil available N, P, K and micronutrients were positively correlated with TOC and decreased with an increase in soil depth under all the agroforestry systems and fallow land. The *Acacia tortilis* based agroforestry system sequestered a higher amount of carbon (0-90 cm) 39.34 Mg C ha⁻¹ followed by *Hardwickia binata* based agroforestry systems.



(37.86 Mg C ha⁻¹), *Tecomella undulata* based agroforestry systems (36.99 Mg C ha⁻¹) and fallow land (30.65 Mg C ha⁻¹). Based on current research findings, it may be concluded that long term agroforestry systems help improve soil available N,P,K and micronutrients status and soil carbon sequestration as compared to fallow land.

INNOVATIVE STRATEGIES FOR ALLEVIATING ABIOTIC STRESS IN PLANTS

Nidhi

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Abstract

In recent years, the progressive escalation of climate change scenarios has emerged as a significant concern and cause widespread disruptions in natural systems, affecting billions of lives globally through its impact on food security. Key abiotic factors such as extreme temperatures, water scarcity, salinity, mineral deficiencies and toxicity are significantly impairing crop productivity and sustainability worldwide. To meet the demands of an ever-growing population, it is essential to boost crop production and productivity, even under these challenging conditions. To overcome these challenges, recent developments in technology and science have incorporated innovative approaches, such as biostimulants, nanotechnology, genome editing and biochar application. Besides, there is a pressing need for novel approaches that can identify and functionally characterize the genes involved in abiotic stress tolerance. This focuses on a range of genomics tools, including QTL mapping, marker-assisted selection (MAS), transcriptomic analysis, genome-wide association studies (GWAS), Next generation Sequencing (NGS), RNA interference (RNAi), CRISPR/Cas and other gene-tagging approaches. These tools offer powerful means to dissect the genetic and functional basis of abiotic stress tolerance. Transcriptome and proteome sequencing was performed on upland cotton (*Gossypium hirsutum* L.) variety under salt stress and integrated analysis was carried out to exploit salt tolerance genes in cotton. A total of 24 DEGs were obtained with significant differential expression. The quantitative real-time polymerase chain reaction (qRT-PCR) validated the two candidate genes responded significantly to the induction of NaCl and play an important role in response to salt stress. The combined use of the aforementioned approaches holds great potential for providing deeper insights into the genetic mechanisms underlying abiotic stress tolerance in crop plants. This, in turn, will strengthen future breeding programs aimed at developing more resilient crops.

INTEGRATED APPROACHES IN PEST AND DISEASE MANAGEMENT FOR SUSTAINABLE AGRICULTURE: ENHANCING POST-HARVEST VALUE ADDITION AND FARMER LIVELIHOODS

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Abstract

The rapid intensification of agriculture has exacerbated pest and disease challenges, often leading to substantial economic losses for farmers. Integrated Pest Management (IPM) combines cultural, biological, mechanical, and chemical control methods to ensure sustainable crop protection. This study explores the efficacy of IPM practices in managing pests and diseases across key crops such as rice, maize, and vegetables. For instance, field trials conducted on rice in Bihar revealed a 45% reduction in pest incidence when pheromone traps and neem-based biopesticides were used, leading to a 30% increase in yield compared to conventional methods. Similarly, introducing *Trichoderma* spp. in vegetable crops reduced fungal diseases by 60%, enhancing productivity by 25%. Post-harvest losses, which account for 20-30% of crop production, were significantly mitigated through pest management interventions. Hermetic storage bags reduced grain loss from 15% to 5% over six months, while solar dryers minimized microbial contamination in horticultural produce. Value addition practices, such as the production of fortified pest-free grain and vegetable powders, improved farmer incomes by 40% in pilot studies. This integrated approach not only addresses pest and disease challenges but also aligns with sustainable management practices by reducing chemical inputs by 50% and ensuring ecological balance. These strategies, coupled with capacity-building programs, can improve farmer livelihoods by an estimated 35% through increased productivity and better market access. The findings highlight the critical role of integrated pest and disease management in achieving sustainable agriculture and augmenting farmer income.



PATHOGENICITY OF *RHIZOCTONIA SOLANI* CAUSING ROOT ROT OF SOYABEAN

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Abstract

Soybean [*Glycine max* (L.) Merrill], belongs to the family Fabaceae and also called a miracle golden bean because of its nutritive value, especially as a substitute of protein. It accounts for approximately 50% of the total production of oil seed crops in the world. According to a survey incidence of root rot in soybean was recorded in the range of 3.29 to 40.33 per cent in various states of India. In Rajasthan, maximum root rot incidence (32.31 per cent) was noticed in Bhilwara district followed by Udaipur (18.90 %) and Kota (18.26 %) districts. Pathogenicity of the isolated fungus was tested on susceptible soybean cultivar “JS 335” growing in pots. The fungus was multiplied on sterilized corn meal sand medium + soil (1:1) and then it was mixed @ 50g/ pots containing sterilized soil. Surface sterilized seeds (1 per cent sodium hypochlorite solution for 2 minutes) of susceptible soybean cultivar “JS 335” were sown in inoculated pots along with inoculated check. The pots were irrigated on alternate days to provide good moisture. After appearance of typical symptoms of root rot disease like; rusty-brown, dry sunken lesions on stems and roots near the soil line as well as defoliation with yellowing stunting growth appearance in the plants. Re-isolation of pathogen was made from such diseased plants and associated fungus was re-identified, based on the morphological and colony characters.

CONSTRAINTS FACED BY WOMEN DAIRY FARMERS IN JAIPUR DISTRICT OF RAJASTHAN

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Abstract

This research delves into the constraints faced by women dairy farmers in Jaipur District, Rajasthan. A comparative analysis was conducted between 40 women dairy cooperative farmers and 40 non-cooperative farmers to identify the specific challenges they encounter. The study employed a mixed-methods approach, combining structured questionnaires and in-depth interviews. The findings revealed that both groups of women farmers face a myriad of constraints, including limited access to credit, inadequate infrastructure, low milk prices, lack of technical knowledge, and socio-cultural barriers. However, cooperative members were found to be more resilient, with access to better market linkages, training, and support services. The study underscores the importance of strengthening women's dairy cooperatives to empower them and improve their livelihoods. Policy interventions aimed at addressing these constraints are crucial to enhancing the sustainability of the dairy sector and empowering women farmers in the region.

ORGANIC FARMING IN INDIA: A PATHWAY TO SUSTAINABLE AGRICULTURE AND HEALTHIER FUTURES

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Abstract

The agriculture sector faces numerous challenges in meeting the rising food demands of an ever-growing population. Conventional farming is one of the most widely practiced approach due to its affordability and accessibility, but it is associated with various drawbacks. To tackle various environmental challenges, a resilient and sustainable agricultural system is essential. Sustainable agriculture includes different ecofriendly farming techniques that boost crop yield and livestock production without having an adverse effect on the environment One such approach is organic farming, which aligns with the principles of sustainability. Organic farming refers to cultivating plants without the use of synthetic additives such as fertilizers, pesticides, or antibiotics. Organically grown food has gained popularity due to its numerous health benefits. India has seen significant growth in organic farming and is now among the leading organic producers globally. Although challenges remain in ensuring organic farming delivers substantial economic and health benefits, its future prospects in India appear



promising. This paper deliberates the current state of organic farming in India along with its components, advantages, associated constraints and future potential.

ADVANCEMENTS IN BIOTECHNOLOGY FOR ENHANCING HORTICULTURAL CROP PRODUCTIVITY, QUALITY, AND RESILIENCE

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Abstract

Biotechnology has significantly transformed the field of horticulture, offering cutting-edge solutions to address the challenges of crop productivity, quality enhancement, and resilience. Traditional methods of crop improvement, such as conventional breeding, often face inherent limitations, including long breeding cycles, restricted genetic diversity, and vulnerability to environmental stresses. In contrast, modern biotechnological techniques such as genetic engineering, molecular breeding, and gene editing have emerged as powerful tools for overcoming these constraints, enabling faster and more precise development of improved horticultural varieties. Genetic modification allows for the targeted introduction of desirable traits into horticultural crops, including increased resistance to pests, diseases, and abiotic stresses like drought and salinity. These techniques also improve critical traits such as nutritional content, flavor, and post-harvest shelf life. For instance, genetically modified (GM) crops such as Bt Brinjal and virus-resistant papaya have shown substantial reductions in pesticide use and crop losses, respectively. Furthermore, the development of advanced genome editing tools like CRISPR-Cas9 enables precise modifications to plant genomes, facilitating the incorporation of desired traits without the introduction of foreign DNA. This not only enhances the accuracy of genetic improvements but also addresses regulatory and consumer concerns related to genetically modified organisms (GMOs). Molecular breeding methods, including marker-assisted selection (MAS) and genomic selection (GS), have also proven invaluable in accelerating the identification and selection of superior genotypes with specific traits, such as disease resistance, fruit quality, and yield potential. These tools offer breeders more efficient means of enhancing crop performance compared to traditional breeding approaches. In addition to improving genetic traits, biotechnology also plays a crucial role in optimizing crop production systems. It helps improve reduce spoilage, and enhance the nutritional value of crops. With the growing demand for sustainable agricultural practices, biotechnological innovations offer great promise for enhancing food security, reducing environmental footprints, and increasing the resilience of crops in the face of climate change.

MOLECULAR AND GENETIC APPROACHES TO IMPROVE ABIOTIC STRESS TOLERANCE IN PLANTS

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Abstract

Abiotic stress factors, such as drought, salinity, extreme temperatures, and nutrient deficiencies, significantly impact global agricultural productivity. These stresses impede plant growth, development, and yield, posing serious challenges to food security and sustainable agriculture. To address these issues, molecular and genetic approaches have emerged as valuable tools for enhancing plant tolerance to abiotic stresses. Recent advancements in molecular biology techniques, including genome editing, transcriptomics, proteomics, and metabolomics, have facilitated the identification of key genes and regulatory networks critical for stress tolerance. Transgenic breeding and molecular methodologies have transformed plant genetics, particularly in enhancing crop resilience to stresses like salinity, heat, and drought. This breeding technique enables precise modification of essential genes, microRNAs (miRNAs), and transcription factors to improve crop performance under stress. Omics technologies, including genomics, transcriptomics, proteomics, and metabolomics, have revolutionized the study of plant responses to abiotic stresses. These approaches, combined with bioinformatics tools, offer an integrated understanding



of the molecular networks involved in stress responses. This integration facilitates precision breeding for crops with enhanced stress tolerance and high yield potential. The synergy between omics technologies and bioinformatics provides a robust platform for developing resilient crops, supporting sustainable agriculture and global food security.

POTENTIAL OF MOLECULAR FARMING FOR HUMAN WELFARE

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Abstract

Molecular farming represents a transformative application of biotechnology that utilizes genetically engineered plants as bio-factories to produce high-value compounds such as therapeutic proteins, vaccines, and industrial enzymes. Molecular farming provides an economically viable and sustainable alternative to conventional production systems, addressing limitations associated with prokaryotic and mammalian cell-based production platforms. Additionally, molecular farming supports sustainability by requiring fewer resources and reducing environmental impact compared to traditional systems. Applications span healthcare, including the production of vaccines and drugs for complex diseases like cancer and infectious diseases, as well as industrial enzyme production for various sectors. Research also explores using molecular farming for agricultural advancements, such as pest-resistant and nutritionally enriched crops. Despite its potential, regulatory challenges remain a significant barrier, particularly in pharmaceutical protein production. However, the lower regulatory constraints for non-pharmaceutical applications make commercialization faster and more feasible. Molecular farming exemplifies the convergence of agriculture and biotechnology, offering a path toward sustainable and scalable production of valuable biologics. With advancements in genetic engineering and a focus on overcoming regulatory hurdles, this innovative approach holds promise for revolutionizing both healthcare and agriculture.

ADOPTION BEHAVIOUR OF TISSUE CULTURE BANANA GROWERS IN ASPIRATIONAL WASHIM DISTRICT OF VIDARBHA

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Abstract

The present study on “Adoption Behaviour of Tissue Culture Banana Growers” was undertaken in 6 villages of Mangarupir, Manora and Washim tahsil of Washim district, respectively in Maharashtra State. The study was undertaken with objectives to study the personal, socio-economic and psychological characteristics of the tissue culture banana growers, to study the adoption behaviour of tissue culture banana growers, to find out relationship between the selected characteristics of tissue culture banana growers with the knowledge and adoption of recommended cultivation practices and to identify the constraints faced by tissue culture banana growers and obtain their suggestions over the constraints. The present study was conducted in Aspirational Washim district from Vidarbha region of Maharashtra State. A purposively sample was used to select tahsils, villages of banana growers. The sample of 120 banana growers were interviewed, personally to collect the data with the help of structured and pretested interview schedule. The collected data were processed and statistically analyze. The coefficient of correlation was used to find out the relationship between the selected independent and dependent variables. The findings revealed that majority of banana growers belonged to middle age group were educated up to college level, possessed semi-medium size land holding category, area under banana. Majority of them had high school and college level education, agriculture is the main occupation of banana growers 35.83 per cent and Majority of banana grower’s annual income found between 1,00,000/ to 2,00,000/-. They used canal as a source of irrigation. Majority of the banana growers were having medium level of experience i.e. 6 -10 years having medium extension contact, innovativeness, scientific orientation and social participation. It was observed that the majority of the banana growers had medium level of knowledge and adoption of



recommended banana cultivation practices. As regards the relational analysis, independent variables namely age, education, land holding, area under banana, source of irrigation, occupation, annual income, experience in banana farming, extension contact and innovativeness found to be positively significant with knowledge whereas, social participation found to be non significant with knowledge. Whereas, age, education, land holding, area under banana, source of irrigation, occupation, annual income, experience in banana farming, extension contact and innovativeness found to be positively significant with adoption whereas, social participation found to be non-significant with adoption. Banana is important fruit crop and having good prospects in Maharashtra. The area under banana is increasing day by day, However, if productivity as compared to other state is poor. It is necessary to find out the knowledge level and adoption of the recommended banana cultivation practices by the banana growers for developing new suitable strategy, to overcome the constraints faced in adoption of recommended cultivation practices by the banana growers. The study revealed that the most of banana growers reported the inconvenient storage conditions, high cost of inputs. Most of the banana growers followed problem about high labour charges. Majority of banana growers having knowledge about recommended cultivation practices in banana and they suggested to start banana processing unit in rural area.

SUGGESTIVE STRATEGY OF TRAINERS OF ARYA TO BETTER RUN THE PROJECT IN BANSWARA DISTRICT OF RAJASTHAN

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Abstract

The livestock sector in India's economy is a significant sub-sector of agriculture. In the form of vital inputs, agriculture is a significant source of income for most of the farmers. Radha Mohan Singh, Former Minister of Agriculture and Farmers Welfare of India stated that agriculture has become an unprofitable business for small and marginal farmers. Attracting and Retaining of Youth in Agriculture (ARYA) was one of the project launched by ICAR in 2015 which creates interest and confidence among the young farmers, making agriculture more and more profitable. The research study was conducted in Krishi Vigyan Kendra of Banswara district in the state of Rajasthan which was selected purposely as Banswara is the only district in which this project has started initially. A total of 140 respondents were selected for the present research study, out of which 120 respondents were trained youth under ARYA project for goat farming and 20 trainers were selected to take suggestions for the betterment of the programme in the study area. The findings of the study suggested that the majority of the ARYA project trainers saw "need to organize special trainings to improve practical skill on goat farming", followed by "timely availability of loan/subsidy", "need to create awareness regarding new technologies to be adopted in goat farming", "fodder should be made available at low cost" and "need to establish regular and reliable marketing network".

CURRENT STATUS, CHALLENGES, AND OPPORTUNITIES IN RICE PRODUCTION IN INDIA

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Abstract

Rice is the staple food for nearly half of the world's population, and its continued production to meet the growing demand from an ever-increasing global population faces many challenges. In 2022-23, India's rice production was estimated at 1357.55 lakh tonnes, which is a record high. This is 62.84 lakh tonnes higher than the previous year's production and 153.65 lakh tonnes higher than the average production over the last five years. The availability of land and water per capita is declining rapidly, and there is a widespread rural-to-urban migration of youth seeking better livelihoods, which reduces the availability of farm labor. Rice is particularly vulnerable to these changes due to its high water and labor requirements. Over the past four decades, the development of high-yielding rice varieties and hybrids, along with the increased use of fertilizers, particularly nitrogen, has been the key drivers of increased rice production. However, the overuse of nitrogen fertilizers has led to significant environmental issues, including global warming, ozone layer depletion, and eutrophication of both surface and groundwater. As a result, there is growing global concern about the environmental impact of excessive nitrogen



application. To address this, nitrogen application rates for rice must be reduced, which could potentially affect production levels. Furthermore, nitrogen use efficiency in rice is the lowest among major cereals, highlighting the urgent need to develop varieties and production technologies that require less nitrogen, water, labor, and pesticides. Achieving these goals will be a tremendous challenge for agricultural scientists.

MARKER-ASSISTED BREEDING AND ITS APPLICATION IN RICE

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Abstract

Rice, a staple food for more than half of the world's population, is grown in >100 countries with 90% of the total global production from Asia. Marker-Assisted Breeding (MAB) has become a pivotal tool in modern agriculture, particularly in rice breeding. Marker Assisted Selection (MAS): An Advanced Molecular Tool in Rice Breeding. MAS is a process in which a marker is used for indirect selection of a genetic determinant or determinants of a trait of interest, i.e., abiotic stress tolerance, disease resistance, productivity, and/or quality. An ideal marker has easy recognition of phenotypes - ideally all possible phenotypes (homo- and heterozygotes) from all possible alleles, Demonstrates measurable differences in expression between trait types or gene of interest alleles, early in the development of the organism and Abundant in number. Technological advances in genomics, bioinformatics, and gene-editing tools like CRISPR are explored, showcasing their role in enhancing MAB's capabilities. Despite its potential, the adoption of MAB faces several challenges, including technical, logistical, economic, and regulatory hurdles, as well as ethical considerations.

ECONOMIC ASSESSMENT OF THE EFFICIENCY OF DIGITALIZED INTEGRATED MARKET IN SIDDIPET DISTRICT, TELANGANA

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Abstract

Successful commercial fresh vegetable production is a challenging task and the efficiency of a vegetable grower can be better increased by understanding the conditions under which the cultivation and marketing is being performed. The present study intends to assess the efficiency of digitalised and modernised integrated market in Siddipet district of Telangana state. The results indicated that there was a reduction in marketing costs which ranged from about 11 percent in tomato and brinjal to about 12 and 13 percent in okra and chilli respectively. There was also a reduction in monetary value of post-harvest loss and the highest was observed in the case of brinjal marketing (6.8 %). On the other hand, tomato growers observed the highest positive increase in consumer's share which was 4.87 percent followed by brinjal growers (4.42%), chilli growers (3.35%) and okra growers (3.02%). The study concluded that the establishment of model rythu bazaar was highly beneficial for vegetable growers and could be adopted for future replications.

APPLICATIONS OF REMOTE SENSING AND GIS IN FORESTRY

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Abstract

Remote sensing has become an omnipresent technique in the scientific field of forestry, and it is also rapidly being employed operationally. However, the pace and extent of remote sensing technology adoption in operational forest inventory and



monitoring projects vary significantly by geographic region .Remote sensing technology and GIS are regarded as powerful and objective tools for monitoring and evaluating natural resources, notably in agriculture and forestry. Climate change creates significant challenges for agriculture and forestry, necessitating the development of new monitoring tools such as remote sensing. It enables the identification of climate effects such as drought, heat stress, and insect infestations. Enhanced technologies like as SAR (Synthetic Aperture Radar), AVHRR detectors and thermal imaging are emphasized for their relevance in providing critical data under severe weather conditions. Through the use of UAVs and satellite imagery, investigators can evaluate vegetation dynamics, land use pattern, crop production, soil quality, detection of changes in the forest canopy, and water resources. High resolution remote sensing LISS-4 data gives us chance to assess the quality of forest in terms of FCD .The rapid depletion of forests made it essential to know the rate and trend loss of forest degradation, so that timely measures could be taken to prevent further loss of forests resources .The structural information and land cover maps are essential for management of wildlife sanctuaries ,national parks, and Reserved forests etc.

STABILITY OF BREAD WHEAT GENOTYPES UNDER LATE SOWN IRRIGATED CONDITION

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Abstract

The experiment was undertaken with a view to estimate $G \times E$ interaction for grain yield and its components and to assess the grain yield potential of different genotypes of wheat under using twenty genotypes. The experiment was conducted at three different locations viz., Agricultural Research Station, Niphad; Agricultural Research Station, Savalvihir and Post Graduate Institute, MPKV, Rahuri under late sown irrigated condition. The experiment was laid in a RBD with three replications for measuring stability of genotypes for different characters. Observations were recorded on nine yield and yield contributing characters viz., Days to 50 % heading, days to maturity, plant height(cm), spike length(cm), number of grains per spike, number of tillers per running meter, thousand grain weight(g), grain yield per plot, protein content (%). The data was subjected to statistical analysis as per Eberhart and Russell model (1966). Stability analysis revealed that environment Niphad and Savalvihir were most favourable among three different environments for expression of most of the characters including grain yield under late sown irrigated condition. Linear and non-linear components of $G \times E$ interaction were found significant for all the nine characters. The genotypes studied recorded differential stability performance for all the characters. The genotype NIAW 4552, NIAW 4558, check variety Phule Samadhan and HD 2932 recorded average stable performance for most of the characters and these genotypes should be further evaluated under Multilocation Trials over the years.

PHENOTYPE-GENOTYPE CORRELATIONS OF TLR2 GENE VARIANTS IN CAMELS SUFFERING FROM MANGE

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Abstract

The present study was conducted to evaluate haematological profile and serum biochemistry in different TLR2 gene variants in Indian camels affected with mange. An experimental trial was conducted involving 30 camel calves of about 2-3 years of age which were having good body condition. All the camels used in the study were reared in farm under uniform standard management conditions and were divided in two groups. Treatment group consisted of animals which were given ivermectin medications as a preventive therapy to mange infection. Control group included no preventive administration of ivermectin. Blood samples were collected from all the animals, Genomic DNA was isolated and genotyping was done based on PCR-Sequence based typing (SBT) method. Sequence analysis of TLR2 gene coding region in these animals revealed mutations at 3 positions i.e. synonymous mutation at c.298 A>C and c.391 C>T, where as non-synonymous mutation at c.342 A>G locus due to change in lysine (K) to arginine (R) amino acid. Three haplotype variants were found and submitted at ncbi repository namely i. e. Haplotype-1- MW589544, Haplotype-2- MW589545 and Haplotype-3 -MW589546. Effect of TLR2 genotypes, haematology and serum biochemical parameters on the mange infections severity were studied. Our study



indicated that there was no significant ($p>0.05$) difference in biochemical parameters between the TLR2 genotypes and the mange infection in Camels.

SERVICES PROVIDED BY FARMER PRODUCER ORGANIZATIONS TO THEIR MEMBER FARMERS IN RAJASTHAN

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Abstract

Farmer Producer Organizations (FPOs) in India play a vital role in empowering farmers by providing various services that help in improving their productivity, risk mitigation, access to extension services, income, storage, processing facilities and market access. These organizations are farmer-focused groups that aim to provide a platform for farmers to collaborate and benefit from economies of scale, reduce transaction costs and increase their bargaining power. The present investigation was undertaken in Bikaner district of Rajasthan state since it is having the largest number of FPOs in agro-climatic zone Ic. Four FPOs namely Marudhara Guar Agro Producer Company Limited, Bikaner Kisan Agro Producer Company Limited, MaruVikas Agro Producer Company Limited and Sahajrasar Farmer Agro Producer Company Ltd. were purposely selected for the present investigation. For selection of respondents, a comprehensive FPO-wise list of farmers registered in FPOs was procured from the DDM NABARD office, Bikaner, Rajasthan. The proportionate random sampling method was used to select the respondents who were having registration under FPOs. Thus, a total of 180 registered member farmers of the FPOs were selected for the present investigation. The findings of the study revealed that the major services provided by FPOs to their member farmers were 'information regarding selection of crop was provided by the FPO', 'FPO supplied sufficient amount of seed to their members', 'FPO assisted to avail loan for purchase of farm implements', 'FPO supported the members to go for value addition of their produce', 'FPO provided vehicle facilities for selling their produce', 'FPO facilitated the members to insure their crops', 'FPO members received the best practices of farming', 'FPO provided the information regarding product specification & market price to their members' and 'FPO conducted trainings related to the crop production'.

BOOSTING BIOSORPTION EFFICIENCY: TRAINING *ASPERGILLUS SULPHUREUS* TO REMOVE COPPER IONS FROM INDUSTRIAL WASTEWATER

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Abstract

The mismanagement and undervaluation of our water resources have resulted in alarming inefficiencies and unsustainable practices. Among the most severe threats are industrial effluents teeming with heavy metals, notorious for their ability to persist in ecosystems, bioaccumulate in the food chain, and pose grave risks to both human health and the environment. The urgency to combat this crisis calls for innovative, eco-friendly solutions to cleanse industrial wastewater of these contaminants. Enter soil fungi—a natural, fascinating ally in the battle against heavy metal pollution. This study shines a spotlight on their remarkable potential as biosorbents, particularly in removing copper from wastewater. By identifying fungal species that naturally resist or tolerate heavy metals, researchers have unlocked strains with unparalleled efficiency. Tested across copper concentrations of 50 to 200 ppm, *Aspergillus sulphureus* demonstrated exceptional biosorption capabilities, achieving removal rates of 16.23% to 37.15% for 50 ppm, 21.15% to 39.29% for 100 ppm, and 16.19% to 30.12% for 200 ppm. Even more promising, trained fungal biomass (ASCuT-50) excelled in absorbing metals from complex mixtures, outperforming its untrained counterpart. These findings pave the way for selectively breeding fungal strains tailored to target specific heavy metals, potentially revolutionizing wastewater treatment. By harnessing this cost-effective, sustainable approach, we can make significant strides toward protecting our water resources and fostering a healthier planet.



REGULATION OF SULPHUR AND NITROGEN IN INDIAN MUSTARD UNDER IRRIGATED CONDITIONS

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Abstract

A field experiment was conducted during 2018-19 and 2019-20 at ICAR-Directorate of Rapeseed-Mustard Research, Bharatpur, Rajasthan to evaluate the effect of nitrogen and sulphur nutrition on growth parameters, seed yield, water productivity and economics of Indian mustard under irrigated conditions under changing scenario. The experiment was carried out in a split plot design with five nitrogen levels i.e., 0, 60, 80, 100, and 120 kg/ha as the main plot treatment and four sulphur levels i.e., 0, 20, 40, and 60 kg/ha as subplot treatment with three replications. Results revealed that the application of 120 kg N/ha recorded the highest plant height (205 cm), leaf area index (5.4), number of leaves/plant (47.3), primary branches/plant (6.8), secondary branches/plant (18.9), SCMR (46.5), number of siliques/plant (382), number of seeds/silique (18), stem girth (6.65 cm), test weight (5.79 g) and seed yield (3.04 t/ha). Among the different S levels, the maximum values of growth and physiological parameters, yield attributes, and seed yield were recorded at 60 kg S/ha (2.71 t/ha). Similarly, production efficiency (22.1 kg/ha/day) and water productivity (1.53 kg seed/m³) were found higher than 120 kg N/ha and 60 kg S/ha. The highest net monetary returns and B:C ratio was recorded with 120 kg N/ha and 60 kg S/ha. Thus, the application of N and S may be revised to 120 and 60 kg/ha, respectively to achieve higher productivity and profitability for Indian mustard in the irrigated semi-arid climates.

THE ROLE OF CIVIL SOCIETY IN SHAPING SUSTAINABLE AGRARIAN POLICY ADVOCACY

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Abstract

The role of civil society in shaping sustainable agrarian policy advocacy has become increasingly critical in the context of global agricultural challenges and environmental sustainability. This study examines how civil society organizations (CSOs), including grassroots movements, non-governmental organizations (NGOs), and community-based organizations (CBOs), influence the formulation and implementation of agrarian policies that prioritize sustainability. By analyzing the strategies, networks, and practices employed by these groups, the research explores their contributions to promoting sustainable agricultural practices, equitable land distribution, and the protection of rural livelihoods. Drawing on case studies and sociological theories of collective action, this study highlights the dynamics of power, participation, and social mobilization that enable civil society to advocate for policy reforms that balance economic, environmental, and social goals. The findings underscore the importance of an inclusive policy process that integrates diverse voices from rural communities to ensure the long-term sustainability of agrarian systems.

KRISHI UPAJ MANDI SAMITI : CORNERSTONE OF FARMER'S INCOME

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Abstract

The agricultural sector in Rajasthan, with over 70% of its population dependent on farming for livelihood. The *Krishi Upaj Mandi* (KUM) system serves as a cornerstone of Rajasthan's agricultural marketing structure, designed to ensure fair pricing and regulated trade for farmers. KUM *samities* Mandais are essential to raising farmers' incomes because they offer a venue for open bidding, free transactions, and access to infrastructure like storage and market data. They play a crucial role in the



agricultural value chain by enabling market connections with traders and processors and enforcing Minimum Support Price (MSP) rules. However, obstacles like the exploitation of middlemen, poor infrastructure, and slow digital adoption continue to limit their full potential are essential for increasing farmers' income because they offer a venue for transparent transactions, competitive bidding, and access to infrastructure like storage and market intelligence. Their role in implementing Minimum Support Price (MSP) policies and facilitating market linkages with traders and processors underscores their contribution to the agricultural value chain. However, challenges such as middlemen exploitation, inadequate infrastructure, and limited digital adoption persist, constraining their full potential. Key reforms such as the integration of e-NAM (National Agriculture Market), the implementation of Minimum Support Price (MSP) systems, and the establishment of cold storage and modern infrastructure have allowed farmers to access broader markets, receive competitive prices, and reduce post-harvest losses. Furthermore, Farmer Producer Organizations (FPOs) have empowered farmers by aggregating produce, enabling direct sales, and improving collective bargaining power. Strengthening the Krishi Upaj Mandi system with modern infrastructure and policy interventions can ensure higher profitability for farmers, reduce post-harvest losses, and significantly contribute to Rajasthan's goal of achieving sustainable agricultural growth and rural prosperity.

PAPAYA, *CARICA PAPAYA* L. CULTIVATION INCREASING IN SIROHI DISTRICT OF RAJASTHAN

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Abstract

Papaya, *Carica papaya* L. is a commercial due to high nutrition and medicinal value including leaves, seeds, ripe and unripe fruits and their juice is used as traditional medicine. Papaya cultivation is done almost in all regions of the world. Its indigenous to tropical America and cultivated in Sri Lanka, Tanzania India, Hawaii, Florida, Philippines, South Africa and Australia. Major cultivated states are Maharashtra, Bengal, Bihar, Haryana, Punjab, Delhi, Andhra Pradesh and Uttar Pradesh in India. In Rajasthan, major production districts are Sirohi, Jalore, Jodhpur, Bhilwara, Bundi, Kota and Ajmer. Sirohi district of Rajasthan is a major in papaya, *C. papaya* cultivation. The total area 203 hectares and an annual production 7760 M.T. increased during last 10 years since 2011-12 to 2021-22 in Sirohi district under papaya. In Rajasthan, the total area under papaya cultivation was 176 hectares and 350 hectares with an annual production of 8210 M.T. and 8769 M.T. during 2011-12 and 2021-22, respectively. In Sirohi, the total area under papaya cultivation was 15 hectares and 218 hectares with an annual production of 450 M.T. and 8210 M.T. during 2011-12 and 2021-22, respectively. The role of Krishi Vigyan Kendra, Sirohi in enhancement of papaya area and production through awareness campaign in papaya cultivation villages, through training programme in tribal areas also, papaya seedlings preparation in nursery, properly papaya cultivation technical supported frequently to farmers community in Sirohi district.

AGRONOMIC FORTIFICATION OF FE AND ZE IN PIGEONPEA FOR NUTRITIONAL SECURITY IN SOUTH EASTERN RAJASTHAN

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Abstract

Pigeonpea is a very important pulse crop of India. The productivity of pigeonpea is very low, it is mainly attributed to their cultivation in poor soils with inadequate and imbalanced nutrient application without the application of micronutrients. Biofortification is the process of creating micronutrient denser staple food crops with increased bioavailable concentrations through agronomic intervention or genetic selection. Biofortification works for twin objective of increasing the concentration of the micronutrients in the grains and simultaneously improving the bioavailability of micronutrients in the grains to alleviate the micronutrient deficiency in human beings and also animals. Agronomic fortification of zinc and iron can be done through soil and foliar applications. The use of micronutrient in pigeonpea is one of the ways to boost up the productivity and to improve the seed quality parameters. Hence, the present investigation was undertaken to study the effect of soil and foliar application of zinc and iron on growth and yield of pigeonpea during *kharif* 2023 at ARS, Kota. The experiment was laid out



in randomized block design with 3 replications. Result showed that the recommended dose of fertilizers (RDF) + foliar application of 0.50% ZnSO₄ + 0.50% FeSO₄ at flowering and pod initiation stage significantly enhanced the pods/plant, seed and stalk yield, net return and B C ratio of pigeonpea compared to RDF and RDF + water spray. The Zn & Fe content in pigeonpea seed increased significantly due to foliar application of Fe and Zn.

POTENTIALITY OF MUNGBEAN AS A SUMMER LEGUME CROP FOR PRODUCTIVITY ENHANCEMENT UNDER EASTERN ZONE OF HARYANA

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Abstract

The continuous practice of the rice–wheat cropping system has led to soil quality depletion and fertility degradation, resulting in a decline in crop productivity. Introducing mungbean as a summer crop during the fallow period (April–June) holds great potential for providing additional income while improving soil health. Cluster Frontline Demonstrations (CFLDs) were conducted to showcase the production potential of improved mungbean cultivation practices. These demonstrations were implemented by Krishi Vigyan Kendra across 44.39 ha in 110 farmers' fields in the Karnal district of Haryana over two consecutive summer seasons (2021 and 2022). Critical inputs for improved production technology were identified through Participatory Rural Appraisal (PRA) in the adopted villages. Traditional farming practices were used as a control for comparison with the recommended practices. Results indicated that the average yield of mungbean under improved practices ranged from 8.5 to 10.2 q/ha, compared to 5.2 to 6.8 q/ha under traditional practices. The maximum seed yield (12.3 q/ha) was recorded in 2021, which was 80.88% higher than the farmers' practice (6.8 q/ha). On average, the improved practices resulted in a 50% yield increase compared to traditional methods. This yield gap can be attributed to differences in crop management practices, soil fertility, and agro-climatic conditions in the Karnal district. The average net profit under improved practices was ₹44,000/ha, compared to ₹18,300/ha under traditional practices. The benefit-cost ratio was also significantly higher under improved practices (3.00) compared to traditional methods (1.92).

MICROCLIMATE MANAGEMENT STRATEGIES FOR CLIMATE SMART HORTICULTURE : PROSPECTS AND CHALLENGES IN INDIAN SCENARIO

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Abstract

Climatic changes have paramount impact on agricultural output both in terms of crop productivity and yield harvested. Further, agriculture significantly contributes to emission of greenhouse gases (GHGs) which exacerbates global warming. A changing climate is threat to agricultural production and food security. The agricultural sector is more vulnerable to economic and physical impacts from climatic fluctuations both at micro and macro regimes. Henceforth, it is imperative to formulate mitigation strategies to curtail the emission sources enhancing GHGs and to adopt techniques for minimizing the adverse effects within natural or human systems for preserving the post-harvest agricultural goods and also biodiversity protection, water and landscape conservation. Crop diversification is the best alternative to mitigate the adversities of climate change for microclimate management as it has scope for restoring soil health, water conservation, maintaining soil biodiversity and carbon content. Climate Smart Horticulture further enhances feasibility to adopt the mitigation strategies for securing quality and quantity of produce by use of climate smart technologies (CSTs) and practices contributing to the microbiome management for soil nutrient balance. It can ensure the nutraceutical value of produce and cut short the inputs on agrochemicals for rearing the crops. Use of bio stimulant formulations for healthy yields and resilience against effects of climatic variations can further ensure healthy crop harvest. CSTs can help farmers in addressing the constraints like extreme drought, extreme precipitation, thermal stress due to micromanagement in seasonal timings. Climate-smart horticulture (CSH)



may transform and reorient agriculture under the current realities of climate change to sustainably increase *productivity*, enhance resilience (*adaptation*), reduce/remove GHGs (*mitigation*) wherever possible, and achieve the global food security goals with emphasis on productivity, adaptation, and mitigation as the three interlinked pillars necessary for achieving this goal. In the Indian scenario, the interventions of Climate Smart Horticulture (CSH) can help to achieve soil health restoration, water management, drought-tolerance, carbon sequestration to restore crop yields, residue recycling and farm waste management at microclimate levels.

APPLICATIONS OF NANOTECHNOLOGY IN AGRICULTURE: A SCIENTIFIC PERSPECTIVE

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Abstract

Nanotechnology has emerged as a transformative tool in the agriculture sector and predictable to become a driving economic force in the near future, addressing challenges in productivity, sustainability, and resource use efficiency. Nano-fertilizers and nano-pesticides offer controlled and targeted release of nutrients and active ingredients, significantly improving their efficiency while minimizing environmental pollution. Nano-carriers, including liposomes and polymeric nanoparticles, facilitate the delivery of agrochemicals, ensuring protracted action and reduced dosage requirements. In soil health management, nano-sensors monitor pH, moisture, and nutrient levels in real-time, allowing precision farming practices. Furthermore, nanotechnology contributes to plant protection through the development of nano-biosensors for early revealing of plant pathogens. Innovative applications like nano-clay and carbon nano-tubes augment soil water retention promoting aeration; however engineered nano materials improve seed germination and stress tolerance in plants. Moreover, smart packaging utilizing nano-composites extends the shelf life of agricultural produce, reducing post-harvest losses. While, concerns regarding the environmental and health impacts of nano-materials required extensive risk assessment and regulatory strategies. This paper outlines the key applications of nanotechnology in the agricultural sector, focusing on precision farming, soil health management, pest control, and crop improvement involving multi-disciplinary approach for revolutionizing agricultural practices. Its integration with digital technologies such as artificial intelligence and IoT, can further strengthen its benefits, fostering sustainable agriculture ensuing global food security for future and upcoming generations.

BIOTECHNOLOGY FOR SUSTAINABLE CROP IMPROVEMENT

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Abstract

The focus of sustainable agriculture is to meet increasing global food requirements without adversely affecting the environment. Agricultural sustainability is a major challenge due to the rising human population, global climate change, and significant environmental degradation. Further, various biotic and abiotic stresses aggravate the challenges posed by global climate change. Achieving sustainability goals requires control over the use of harmful chemicals, the quantity and quality of water, the type of seed source, the surrounding abiotic parameters, and the biome. Biotechnology is technology that utilizes biological systems, living organisms or parts of this to develop or create different products. Biotechnology mainly contains, Plant Tissue Culture, Molecular Biology, Genetic Engineering and Genome editing etc.

The applications of genetic engineering technologies are helpful in improving the yield and quality of rice, maize, and wheat. Gene editing technologies have revolutionized molecular biology and genetics, with CRISPR-Cas9 emerging as a groundbreaking innovation. Initially identified as a bacterial adaptive immune system, CRISPR-Cas9 has been adapted for precise genetic modifications across various organisms, including humans, plants, and animals. This system employs a guide RNA to direct the Cas9 enzyme to specific DNA sites, where it induces double-strand breaks. These breaks are repaired via non-homologous end joining or homology-directed repair, enabling precise addition, deletion, or correction of genetic sequences with remarkable specificity and efficiency. Another important technique tissue culture, in combination with molecular techniques, had been successfully used to incorporate specific traits through gene transfer. In vitro techniques for the culture of protoplasts, anthers, microspores, ovules and embryos had been used to create new genetic variations in the



breeding lines through haploid production. Cell culture has also produced somaclonal and gametoclonal variants with crop-improvement potential.

GENETIC VARIABILITY AND MULTIVARIATE ANALYSIS IN FENUGREEK (*TRIGONELLA FOENUM-GRÆCUM* L.) GERMPLASM LINES

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Abstract

The present study Genetic variability and multivariate analysis in fenugreek (*Trigonella foenum-graecum* L.) germplasm lines, was conducted at the College of Agriculture, JNKVV, Jabalpur during 2022-2023, to explore the genetic diversity among 27 distinct fenugreek genotypes. The morphological analysis revealed significant variations in traits such as days to flowering initiation, plant height, number of branches per plant, number of pods per plant, pod length, number of seeds per pod, number of leaves per plant, leaf area, test weight, days to maturity, yield per plant, and yield per hectare. Genotypes like AM 319, with early flowering, showed potential for faster maturity, allowing breeders to select genotypes for specific cultivation cycles. FGK-150 displayed a correlation between early flowering and taller plant height, offering further exploration avenues. The assessment of heritability and genetic advance indicated the potential for trait improvement through selective breeding and traits with high heritability and significant genetic advance, such as test weight, hold promise for enhancement, while traits like pod length, with lower genetic advance, may see limited improvement. A positive phenotypic correlation between early flowering and early maturity (0.7343) assists in selecting genotypes for specific timelines, while negative genotypic correlations, such as between plant height and days to flowering initiation (-0.593), inform breeding decisions. D2 analysis elucidated that among genotypes, with higher intra-cluster distances in Clusters III and IV indicating greater diversity. The study provided a comprehensive evaluation of genetic diversity in fenugreek, to inform and enhance crop improvement strategies. The identification of diverse genotypes with desirable traits supports the development of improved fenugreek varieties, contributing to agricultural sustainability and productivity.

MORPHO-PHYSIOLOGICAL EFFECT OF PLANT GROWTH REGULATORS ON PRODUCTIVITY AND SEED QUALITY OF SOYBEAN [*GLYCINE MAX* (L.) MERILL]

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Abstract

The current study was carried out on soybean variety JS 20-98 seeds that were treated to varying concentrations of plant growth regulators (PGRs). These seeds were used in field studies using Randomised Block Design (RBD) with four replications, and the observations were recorded on phenophasic observations, such as days to 50% flowering, days to pod formation, days to seed formation, days to physiological maturity, and days to field maturity. Determination of dry matter production and its partitioning in various plant parts (leaves, branches, main stem, and pod) at 45 DAS, 60 DAS, 75 DAS, and 90 DAS. Physiological observations (Growth analytical parameters), Leaf Area Index (LAI), Leaf Area Duration (LAD), Crop Growth Rate (CGR), Relative Growth Rate (RGR), Specific Leaf Area (SLA), Specific Leaf Weight (SLW), Biomass Duration (BMD), Chlorophyll Content Index (CCI), Relative Water Content (RWC). Yield and yield components included viz; plant height (cm), number of branches plant⁻¹, number of pods plant⁻¹, number of seeds pod⁻¹, pod length (mm), pod width (mm), pod girth (mm), seed index (g), seed yield (g plant⁻¹ and kg ha⁻¹), biological yield (g plant⁻¹ and kg ha⁻¹), harvest index (%). The biochemical estimation includes moisture (%), ash (%), crude fibre (%), total carbohydrate (%), protein (%), and fat (%). However, seed quality traits include germination (%), seedling length (cm), seed vigour index-I, seed vigour index-II, seedling dry weight (g), root length (cm), and shoot length (cm) in soybean. The treatment GA @ 3 ml L⁻¹ (T5) produced the



highest seed yield of 2429.93 kg ha⁻¹, biological yield of 6804.47 kg ha⁻¹, and harvest index of 35.71% among the six PGR treatments on soybean. The greatest value for seed quality parameters, especially germination (%), seedling dry weight (g), seedling length (cm), seed vigour index-I, and seed vigour index-II was recorded under the treatment GA @ 3 ml L⁻¹ (T5).

PRINCIPAL COMPONENT ANALYSIS AND GENETIC DIVERGENCE STUDIES FOR YIELD AND QUALITY RELATED ATTRIBUTES OF HYBRID RICE

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Abstract

This study Conducted during the Kharif 2022 season at the Seed Breeding Farm, Rice Improvement Project, Department of Plant Breeding & Genetics, JNKVV, Jabalpur, the research focused on 98 genotypes, evaluating 30 agronomic attributes based on DUS guidelines. Genetic variability, heritability, genetic advance, correlation, path coefficient, D2 analysis, and PCA were employed to analyze the data. The findings reveal significant genetic diversity among the genotypes, with traits like stem length, fertile spikelets, and panicle weight contributing notably to genetic divergence. PCA identified eight principal components accounting for 81.97% of the total variability, with the first component alone contributing 22.34%. The study emphasizes the importance of understanding genotypic and phenotypic characteristics for effective selection and breeding of diverse genotypes, ultimately enhancing hybrid rice technology and regional adaptability. The research highlights key traits contributing to genetic divergence and provides insights into the genetic architecture of hybrid rice, aiding in the development of high-yield, quality rice varieties. The comprehensive analysis of yield and quality traits offers a valuable resource for breeders aiming to improve hybrid rice cultivars, ensuring food security and nutritional value for the global population.

NITROGEN SPLIT APPLICATION ON GROWTH AND YIELD OF DRILLED RICE (*ORYZA SATIVA* L.)

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Abstract

A field experiment entitled “Split application of nitrogen on growth and yield of drilled rice (*Oryza sativa* L.)” was carried out at College of Agriculture, Dr. PDKV, Sonapur, Gadchiroli during *kharif* season of 2021-22 on sandy clay loam soil. The experiment was laid out in split plot design with three replication, to study the effect of split application of nitrogen on growth characters, yield attributes, yield, nutrient uptake and economics of drilled rice crop. The factor A consisted application of three different dose of nitrogen viz. 75, 100 and 125 % RDN, while the factor B consisted of application of nitrogen with three different split viz. S1 (50 % RDN basal dose at sowing + 50 % RDN at 30 DAS), S2 (33 % RDN basal dose at sowing + 33 % RDN at 30 DAS + 33 % RDN at 60 DAS) and S3 (25 % RDN basal dose at sowing + 25 % RDN at 30 DAS + 25 % RDN at 50 DAS + 25% RDN at 70 DAS). The initial and final plant stand was not influenced significantly due to different split application of nitrogen. Growth characters like plant height, number of tillers per plant, number of tillers per m², number of functional leaves per plant, leaf area index per plant and dry matter accumulation per plant were significantly affected due to different levels of nitrogen application in drilled rice crop. The application of 125 % RDN (Treatment N3) recorded significantly higher plant height (87.44 cm), number of tillers per plant (9.77), number of tillers per m² (429.30), number of functional leaves per plant (21.89), leaf area index per plant (4.59) and dry matter accumulation per plant (29.14 g). The split application of nitrogen treatment S2 (33 % RDN basal dose at sowing + 33 % RDN at 30 DAS + 33 % RDN at 60 DAS) recorded significantly higher plant height (87.22 cm), number of tillers per plant (9.73), number of tillers per m² (433.35), number of functional leaves per plant (21.96), leaf area index per plant (4.64) and dry matter accumulation per plant (28.46 g). The similar trend was observed for treatment N3 (125 % RDN) in nitrogen dose application for number of panicles per plant (12.74), length of panicle (21.18 cm), weight of panicle per plant (2.49 g), number of filled spikelets per panicle (121.33), test weight (15.88 g) and hulling % (75.19). The split application of nitrogen with treatment S2 (33 % RDN basal dose at sowing + 33 % RDN at 30 DAS + 33 %



RDN at 60 DAS) recorded the significantly higher number of panicles per plant (12.63), length of panicle (21.41cm), weight of panicle per plant (2.50 g), number of filled spikelets per panicle (122.00) and test weight (15.82g). Application of 125 % RDN recorded significantly higher grain yield (4006 kg ha⁻¹), straw yield (5239 kg ha⁻¹) and biological yield (9245 kg ha⁻¹) and also with split application of nitrogen treatment S2 (33 % RDN basal dose at sowing + 33 % RDN at 30 DAS + 33 % RDN at 60 DAS) recorded significantly higher grain yield (3868 kg ha⁻¹), straw yield (4946 kg ha⁻¹) and biological yield (8813 kg ha⁻¹). Split application of nitrogen S2 and 125 % RDN recorded significantly higher nitrogen, phosphorous and potassium content in grain and straw at harvest and similarly recorded the higher values of nitrogen, phosphorous and potassium uptake. The GMR, NMR and B:C ratio per hectare were found higher with 125 % RDN and treatment S2 (33 % RDN basal dose at sowing + 33 % RDN at 30 DAS + 33 % RDN at 60 DAS) split application of nitrogen.

SURVEY ON THE INCIDENCE OF MAIZE FALL ARMY WORM IN MADURAI DISTRICT, TAMIL NADU

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Abstract

In India, maize is the third important crop after rice and wheat. Besides food, it also provides feed and fodder and is an important source of basic raw material for number of industrial products, viz., oil, starch, alcoholic beverages, bio-fuel etc. Maize fall armyworm (FAW), *Spodoptera frugiperda* (J.E. Smith) is an invasive insect with more than 80 hosts. In India, it was first reported from Shivamogga, Karnataka in 2018. Thereafter, it spread to most of the states in India and became a threat to Indian Agriculture and food security. Due to its polyphagous and hidden nature, management of FAW became dubious. In this context, monitoring of FAW occurrence and incidence levels is of utmost important in its management. Keeping this in view, a fixed plot study was conducted at Agricultural College and Research Institute, Madurai. Simultaneously, a roving survey was conducted in Madurai district at weekly intervals during 2021 to 2022. During the roving survey, minimum and maximum whorl damages recorded were 4% and 16% respectively with mean whorl incidence was 9.8%. In tasseling stage, minimum and maximum tassel damages recorded were 4% and 7% respectively. Mean tassel damage recorded was 5.3%. In cobbing stage, minimum and maximum cob damages recorded were 2% and 9% respectively. Mean cob damage recorded was 8.5%. In harvesting stage, very less cob damage was observed i.e., 1.0 to 2.0%. In the fixed plot study, at 7 days after emergence (DAE), no whorl incidence was observed. At 14 DAE, 10% whorls were affected by fall army worm. Maximum whorl damage of 22% was recorded on 21 DAE. During tasseling stage, 4.0 to 6.0 per cent damaged tassels were observed in the field. In cobbing stage, 8% damage was observed. Overall, during 2021-22, maximum per cent damages of whorl, tassel and cob recorded were 22%, 9% and 9% respectively.

EFFECT OF PRIMING TECHNIQUES ON QUALITY PARAMETERS IN SOYBEAN (*GLYCINE MAX* L.)

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Abstract

Several factors of harvest, processing, transportation, storage, and genetic characteristics have resulted in seed deterioration. Seed priming is controlled hydrating of seeds that enhance quality, reduce lipid peroxidation, and trigger biochemical activities. From the results indicated, this process improves crop growth and productivity by shortening the germination and emergence periods of the seeds. Acceleration of uniform seed germination is essential in order to attain maximum plant stand through the treatment applied. Seed priming at T7-CaCl₂ @ 1.5% exhibited higher germination and seedling length, of 86.33% and 18.58 cm, respectively, as compared to the control as well as other treatments. Enhanced physiological events in germination may be the causes of good efficiency protection against pests that causes beneficial effects of priming treatment. Treatment T3 GA₃ @ 50 ppm and T7-CaCl₂ @ 1.5% presented maximum seedling lengths. All other treatments produced



greater seedling lengths compared to these two. All seed priming treatments were significantly varied for total dry weight and vigour index I and II. With regard to the study, the investigation made conclusions that seed yield and seed quality improved due to the seed priming treatment in soybean variety AMS-MB 5-18.

ENHANCING SEED QUALITY PARAMETERS THROUGH PRIMING TECHNIQUE IN SOYBEAN (*GLYCINE MAX* L.)

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Abstract

Soybean is the largest source of oil and protein, accounting for a major portion of world oilseed production. Seed priming or regulated hydration apart from helping enhance the germination of seeds keeps them fresh. It has reduced lipid peroxidation, and increased biochemical activities, and sugars. Various seed priming treatments significantly influenced seedling stand at planting, days to 50% flowering, pod setting, seed yield per hectare, and harvest index. T7 and CaCl₂ @ 1.5% were some of the most effective priming treatments which recorded the least days to field emergence at 4.03 days. Seed priming also enhanced plant productivity as it elevated to new heights T7 CaCl₂ @1.5% in achieving the maximum initial stand populations. Treatments of seed priming also obtained the yields of the seeds with better yield-contributing traits, particularly more pods per plant and even higher seed yield by T7 CaCl₂ @1.5%. Seed conditioning also improves the quality parameters of the seeds and characters of yield in soybean varieties; however, seed soaking with growth regulators/chemicals leads to better seed quality, crop stand, morpho-physiological parameters, and crop yield.

IN VITRO RHIZOGENESIS STUDY OF SPINE GOURD (*MOMORDICA DIOICA* ROXB.)

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Abstract

The present investigation entitled “*In vitro* rhizogenesis study of spine gourd (*Momordica dioica* Roxb.)” was conducted with objectives to optimize parameters for *in vitro* root maximization and to standardize hardening protocol of spine gourd. The experiment was conducted at plant tissue culture laboratory, Biotechnology Centre, Department of Agricultural Botany, PGI, Dr. PDKV, Akola during 2022-23 and 2023-24. The experiment was laid out using CRD using different treatment combination of half basal nutrient media with 30 shoots of *in vitro* grown cultures in three replication. For the sterilization of shoot tip and nodal segment mother explants, were treated with combinations 0.1% for Bavistin, Streptomycin for 25-30 min. respectively, and concentration of HgCl₂ were kept at 0.1% for 5 min. treatment duration found the best. The explant source used as nodal segment of 3-4 years aged mother plants were observed optimum for obtaining higher shoot proliferation and high rate of shoot multiplications in spine gourd using local cultivar. The explants exhibited differential response to the *in vitro* conditions. Shoot multiplication was carried out by using already standardized treatment MS+ BAP (2 mg l⁻¹) + LGA (2 mg l⁻¹) with 8.97 multiples per shoot. Developed shoots were rooted on half MS medium supplemented with different combinations of IBA & IAA. The effect of half MS medium with different concentrations of IBA & IAA on *in vitro* rooting of spine gourd resulted with minimum number of days i.e. 12.88 days required for root initiation was observed in the *in vitro* produced shoots placed in half MS + IBA (2.0 mg l⁻¹). The maximum number of roots i.e. 4.22 roots was observed in the *in vitro* produced shoots placed in half MS + IBA (2.0 mg l⁻¹) and the maximum length of root i.e. 9.75 cm was found in the *in vitro* produced shoots placed in half MS + IBA (2.0 mg l⁻¹). The maximum length of shoot 5.37 cm was found in half MS + IBA (2.0 mg l⁻¹). The maximum number of leaves in half MS + IBA (2.0 mg l⁻¹) were recorded with 10.07. The lowest percent of non-embryonic callus 25.55 % formed in half MS + IBA (2.0 mg l⁻¹). The highest percentage of rooting 78.02% was recorded on 28th day from the day on which *in vitro* produced shoots were transformed on rooting media. Effect of different hardening



media on hardening of *in vitro* rooted plantlets was studied in which maximum plant height was found in peat moss (100%) which was 17.35 cm, tuber formation was also taken place in minimum days *i.e.* 63.99 days with maximum survival 66.62%. *Ex vitro* rooting and hardening of spine gourd was done in different hardening media before that plantlets were deep in 200 mg l⁻¹ IBA for 4 min. in that maximum plant height was found 16.47 cm with 54.90 % survival in peat moss (100%). The present study will be helpful for rapid *in vitro* multiplication of elite species of spine gourd.

INTEGRATING SPEED BREEDING WITH GENOMIC TOOLS FOR RAPID CROP DEVELOPMENT

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Abstract

Global agriculture must address the urgent challenges of increasing food production for a growing population while adapting to climate change. Traditional crop breeding methods, though effective, are slow, often taking over a decade to produce improved varieties. Speed breeding, a revolutionary technique that accelerates plant growth cycles in controlled environments, offers a solution by enabling up to six crop generations annually. This is achieved by optimizing environmental factors like photoperiod, temperature, and light intensity, drastically reducing breeding timelines. The true potential of speed breeding is realized when integrated with advanced genomic tools. Techniques such as genome-wide association studies (GWAS) and marker-assisted selection (MAS) allow precise identification of genetic markers for traits like disease resistance, drought tolerance, and yield enhancement. Similarly, genomic selection (GS) utilizes whole-genome data to predict plant performance, streamlining the breeding process.

The incorporation of CRISPR/Cas9 gene-editing technology further amplifies the power of speed breeding. This precise tool enables targeted modifications of key genes, facilitating the rapid development of crops with improved traits such as abiotic stress tolerance. Practical applications in crops like wheat, barley, and rice have demonstrated significant reductions in breeding cycles while achieving notable genetic advancements. Moreover, high-throughput phenotyping technologies and bioinformatics platforms provide critical support, enabling efficient data analysis and real-time monitoring of plant performance during speed breeding cycles. Despite its transformative potential, challenges such as high initial infrastructure costs, scalability, and adaptation of diverse crops to controlled environments remain. Addressing these barriers through research collaborations, public-private partnerships, and capacity building is essential. In conclusion, the integration of speed breeding with genomic tools represents a groundbreaking approach to sustainable agriculture, ensuring food security and fostering climate-resilient crops.

KEY FACTOR FOR CROP PRODUCTIVITY: CROPPING SYSTEM, AGRONOMIC AND SOIL HEALTH MANAGEMENT, INDIGENOUS TECHNICAL KNOWLEDGE AND IPR ISSUES

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Abstract

Crop productivity is influenced by a combination of factors that can be categorized into three main groups: environmental (temperature, Soil fertility, texture, moisture, Topography, Water availability and quality), managerial (Crop selection and variety, Planting density and pattern, Irrigation and water management, Fertilization and nutrient management, Pest and disease management, Pruning and training practices) and genetic (Crop breeding and genetic improvement, Hybridization and varietal selection, Genomic research and marker-assisted selection). Additionally, socioeconomic factors such as market access, credit availability, and farmer education also play a crucial role in determining crop productivity. Understanding the interplay between these factors is essential for developing strategies to improve crop productivity, ensuring food security and promoting sustainable agriculture. Cropping systems have a significant impact on soil health including: Soil erosion and nutrient depletion, Soil fertility and structure improvement, Biodiversity and ecosystem services enhancement, Water



retention and quality improvement, Carbon sequestration and climate change mitigation. It's important to note that the specific impacts will vary depending on factors like local conditions, crop selection, and management practices. Indigenous technical knowledge (ITK) in agriculture refers to the traditional farming practices, techniques, and knowledge passed down through generations of indigenous communities and also addressing these IPR (Intellectual Property Rights) issues is crucial for promoting sustainable agriculture, ensuring food security, and protecting the rights of farmers and indigenous communities.

INTERPRETATION OF SPECTROSCOPIC STUDIES

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Abstract

The complete interpretation of spectroscopic studies and at length survey pointed out that benzene & its derivatives, n-heterocyclic compounds with its derivatives, methoxy benzene and its derivatives are of considerable importance due to biological, ecological & medicinal aspects. Methoxy benzene is more electron rich than C₆H₆ because of the resonance effect of the methoxy group upon the aromatic ring. The resonance effect has greater effect upon the π cloud of ring than the inductive effect. It reacts with electrophiles in the electrophilic aromatic substitution reaction rapidly than C₆H₆ which in turn reacts rapidly than nitrobenzene. Derivatives of methoxy benzenes occurs naturally in a variety of foods and plants such as fennel. C. Miller et al. N.R. Drink water have shown the chronic toxicity, carcinogenicity, genotoxicity over rats of allyl methoxy benzene.

GENETIC VARIABILITY AND TRAIT ASSOCIATION STUDIES IN INDIAN MUSTARD (*BRASSICA JUNCEA* L.)

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Abstract

Indian mustard (*Brassica juncea* L.) is a vital oilseed crop extensively cultivated for its edible seeds and oil. This study assessed genetic variability and trait associations across 20 mustard genotypes during the Rabi season of 2022 at Sam Higginbottom University of Agriculture, Technology, and Sciences, Prayagraj. Using a Randomized Block Design with three replications, 13 agronomic traits were evaluated to explore variability, heritability, and correlations. Results revealed significant genetic variation among genotypes, with Pusa Bold and DRMR 150-35 exhibiting the highest seed yield per plant compared to DRMR IJ-31. High Genetic and Phenotypic Coefficients of Variation (GCV and PCV) were observed for the number of secondary branches, indicating potential for genetic improvement. Traits such as siliquae on the main shoot and seed yield per plant displayed high heritability and genetic advance, underscoring their breeding importance. Correlation and path coefficient analyses revealed that the number of siliquae on the main shoot and primary branches had the strongest positive direct effects on seed yield. Additional traits, including days to flowering and test weight, also contributed significantly. These findings highlight key traits for selection, providing a roadmap for enhancing mustard yield and quality.

AN ECONOMIC ANALYSIS OF CULTIVATION AND MARKETING OF MAJOR SEASONAL FLOWERS IN JAIPUR DISTRICT OF RAJASTHAN

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Abstract

Flower cultivation has been widely recognized to enhance agricultural yields, positively impacting pollinator population and



diversity. Floriculture has established itself as a vital contributor to the Indian agriculture. However, the precise viability of this ‘low volume, high value’ enterprise has been uncertain. The present investigation was undertaken in Jaipur district of Rajasthan, India, with a view to study the economic aspects of major seasonal flowers viz., marigold, chrysanthemum and gaillardia. Primary data for the *rabi* season 2023 were collected from a sample of 60 farmers and 15 market intermediaries and analyzed alongside secondary data from government publications and records. The investigation observed that cost of human labour followed by seed and planting material were the major components of the cost of cultivation of seasonal flowers. In case of marketing costs, quantity losses followed by transportation and labour charges accounted for a major share in total marketing costs of the selected flowers. A majority (58.33%) of farmers adopted Channel II (Producer ? Wholesaler cum Commission Agent ? Retailer ? Consumer) for marketing their produce. Findings highlight the potential of flower cultivation as a high-value crop alternative as well as various challenges faced by seasonal flower growers, such as high cost of seed and planting material and fluctuations in market price. Thus, an impetus for the development of floriculture infrastructure in the study area is recommended to serve as a benign alternative to improve farmers’ competitiveness and enhanced profitability of seasonal floriculture.

NEXT GENERATION SEQUENCING BASED TRANSCRIPTOME ANALYSIS FOR NEMATODE RESISTANCE IN TOMATO

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Abstract

The research work comprises the transcriptome analysis of tomato genotypes namely, AT-3 (*S. lycopersicum*), SL 120 (*S. lycopersicum*), LA 1777 (*S. habrochaites*) and LA 2157 (*S. arcanum*) under nematode, nematode viz., *M. incognita* stress. The sequencing was done on the Illumina MiSeq platform that yielded 5.24 GB of raw data. Overall alignment with reference sequences of the *Solanum lycopersicum* assembly SL3.0 was found 85.60% and with *M. incognita* V3 assembly, was 9.80%. AT-3 (*S. lycopersicum*), SL 120 (*S. lycopersicum*), LA 1777 (*S. habrochaites*), and LA 2157 (*S. arcanum*) got aligned with tomato reference genome with a similarity of 75.37%, 82.05%, 73.04%, and 69.24% respectively. The BlastX result displayed 80.76% of blasted sequences mapped and 73.07% annotation. Maximum sequences, up to 94% were mapped with UniProtKB. The top Blast hit was for *S. lycopersicum* followed by *S. pennellii*. The highest evidence code distribution was found for IEA (Inferred from Electronic Annotation). The highest enzyme code distribution was obtained for hydrolases. Gene ontology, acquired for defense response, response to stress, response to fungus, and response to biotic stimulus. PC1 captured 41.3% variance and PC2 represented 31.2%. Differential gene expression was illustrious for the chitinase activity, PAL, SAM, BURP, and peroxidases. All the transcripts of nematode-infected tomato samples had 85 KEGG pathways. The validation of the defense-related genes through real-time PCR was attained for genes of chitinase, pathogenesis-related, LeHSP, SAM, LYC WRKY, and MYB TF.

RECENT ADVANCES IN IDEAL NURSERY RAISING FOR VEGETABLE SEEDLINGS

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Abstract

Recent innovations in vegetable nursery management have significantly enhanced seedling quality, resource efficiency, and overall productivity. One of the key advancements is the introduction of automated greenhouses, which utilize sensors and climate control systems to regulate environmental factors such as temperature, humidity, and light. This precise control allows for year-round production under optimal conditions, ensuring consistent seedling growth. Using mist chambers with fogger systems has further refined humidity and temperature regulation, creating a uniform environment that promotes higher germination rates while reducing water consumption. Additionally, growing rooms offer fully controlled environments for off-season seedling production, contributing to faster and healthier growth cycles. A breakthrough is the use of aeroponics, especially for crops like



potatoes. In this system, plant roots are suspended in air and misted with nutrient solutions, resulting in accelerated growth and higher yields than traditional soil-based methods. Alongside aeroponics, improvements in growing media, such as soilless substrates, have enhanced water retention and root aeration, fostering more robust seedling development. The adoption of pro trays (cell trays) has improved nursery practices by ensuring uniform root growth and facilitating easier, less stressful transplanting. Grafting techniques, especially in solanaceous crops, have improved resistance to soil-borne diseases and increased plant vigor. The application of plant growth regulators (PGRs) has also contributed to optimized growth phases, ensuring uniform seedling development and improved overall performance. Collaborations such as the Indo-Dutch and Indo-Israel projects have brought advanced technologies and expertise to Indian vegetable nurseries, enabling the adoption of precision agriculture. In addition, farmer innovations and government schemes, such as those under the Mission for Integrated Development of Horticulture, provide support through subsidies and training to help farmers adopt these advanced practices.

RECENT TRENDS IN ECO-FRIENDLY MANAGEMENT OF AGRICULTURAL INSECT PESTS

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Abstract

The increasing concerns over the adverse effects of conventional chemical pesticides on human health and the environment have prompted researchers to explore sustainable alternatives for managing agricultural insect pests across the globe. One such approach is the use of genome editing techniques, which can be leveraged to develop crop varieties with enhanced resistance to insect pests. Additionally, the development of Internet of Things (IoT)-based systems has allowed for the integration of various physical and biological control methods, such as the use of light, heat, and microbial biocontrol agents, to prevent and manage crop diseases and insect pests in an environmentally friendly manner. Further, woefully widespread use of neonicotinoid insecticides have been linked to declining the populations of beneficial insects like pollinators, has also motivated the search for alternative pest control strategies. Researchers have explored the potential of agronomic practices such as diversifying crop rotations, altering planting and irrigation schedules, and using less susceptible crop varieties to manage insect pests without relying on harmful chemicals. Microbial biocontrol agents, such as *Bacillus*-based nano-bioformulations, have also shown promise in controlling phytopathogens and insect pests. These environmentally-friendly approaches not only reduce the negative impact on the ecosystem, but also contribute to the sustainability of agricultural practices. Merrily, recent trends reflect a global movement towards sustainable agriculture, aiming to balance effective pest management with environmental conservation.

MANAGEMENT OF ROOT ROT OF COWPEA INCITED BY *RHIZOCTONIA BATATICOLA* THROUGH BOTANICALS AND BIOAGENTS

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Abstract

Cowpea [*Vigna unguiculata* (L.) Walp] is an important annual legume crop in India. The crop suffers from several disease among those root rot is emerging as a major problem in cowpea cultivation. Infected root parts of cowpea were collected from farmer's field. Pathogen was isolated, purified and identified as *Rhizoctonia bataticola* [*Macrophomina phaseolina* (Tassi.) Goid] and its pathogenicity was proved. The extract of botanicals of six plant species were evaluated at three concentrations (5%, 10% and 15%) against *Rhizoctonia bataticola* by Poisoned Food Technique. Garlic (86.43, 93.96 and 97.16%) followed by neem leave extract were found most effective in inhibiting mycelial growth at different concentrations. When botanicals were tested under field condition applied as seed treatment, garlic was found most effective with maximum disease control (48.78% at 10%) followed by neem leaves extract. Four bio-agents were evaluated against *Rhizoctonia bataticola* by dual culture technique. Among all the tested bio-agents *Trichoderma harzianum* was found best which inhibit maximum mycelial



growth of fungus (79.87%) followed by *Trichoderma viride*. When bio-agents were used as seed treatment under field conditions, *Trichoderma harzianum* was found most effective with maximum disease control (48.13% @ 6g/kg) followed by *Trichoderma viride*.

EYES IN THE SKY : TRANSFORMING AGRICULTURE THROUGH REMOTE SENSING

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Abstract

Remote sensing has transformed agricultural methods by offering extensive, real-time information about crop vitality, soil characteristics, and environmental factors. This technology integrates essential components like sensors (multispectral, hyperspectral, thermal, and radar), platforms (satellites, UAVs, and ground-based systems), and sophisticated data-processing tools driven by artificial intelligence and machine learning. Collectively, these elements allow for effective data gathering and analysis, supporting informed choices in precision farming. The benefits of remote sensing in agriculture are numerous. It enables extensive observation of agricultural lands, prompt identification of crop distress caused by pests, diseases, or nutrient shortages, and improved management of resources for irrigation and fertilization. Furthermore, it assists in predicting yields, assessing soil moisture, and delineating agricultural areas, thereby boosting productivity while reducing environmental consequences. The capability to reach remote or expansive areas makes remote sensing a vital instrument for contemporary farming. Anticipating the future, the role of remote sensing in agriculture will focus on the integration of advanced technologies such as hyperspectral imaging, affordable nano-satellites. The combination of real-time data analysis with cloud computing and blockchain for clear data sharing will provide farmers and stakeholders with practical insights. These innovations are expected to improve food security, sustainability, and resilience in agricultural practices, establishing remote sensing as a fundamental element of future farming strategies.

INNOVATION IN CROP IMPROVEMENT IMPACT OF CLIMATE CHANGE ON AGRONOMY

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Abstract

Innovation in crop improvement is critical to addressing the challenges posed by climate change on agronomy. Climate change, characterized by rising temperatures, unpredictable rainfall, and extreme weather events, has significantly impacted crop yields, pest dynamics, and soil health. This study examines how advancements in crop improvement, such as genetic engineering, marker-assisted breeding, and climate-resilient crop varieties, can mitigate these effects. Innovations focus on developing crops with enhanced drought tolerance, heat resistance, and improved nutrient-use efficiency. Integrating precision agronomy techniques, such as real-time weather monitoring and data-driven farming practices, further supports adaptation to changing climatic conditions. The research highlights the role of sustainable approaches, including the use of biotechnological tools and ecological principles, in fostering resilient agronomic systems. By bridging the gap between scientific innovations and practical applications, this study emphasizes the importance of adaptive strategies to safeguard food security and promote sustainable agriculture in the face of climate change.

RESPONSE OF DIFFERENT LEVEL OF BULKY ORGANIC MANURE AND BIOCHAR ON SOIL PARAMETERS AND YIELD ATTRIBUTES OF MAIZE (*ZEA MAYS* L.) VAR. SURABHI

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Abstract

A trial was conducted on maize during *zaid* season 2023. The soil was sandy loam in texture. The experiment was laid down in



randomized block design with three levels of NPK. The treatment combinations were replicated three times and allocated at random in each replication. The result shows that the application of different levels combination of NPK and FYM and Biochar T₉ - [NPK @ 120:60:40 Kg ha⁻¹ + FYM @ 125 t ha⁻¹ + Biochar @ 5 t ha⁻¹] showed that the slight decrease in pH, bulk density and particle density; there is significant increase in pore space, water holding capacity, EC, organic carbon, Available Nitrogen, Phosphorus, Potassium and plant growth and yield attributes, gave best results with respect to plant height (cm), number of leaves plants (Kg ha⁻¹), number of cob plant (Kg ha⁻¹), Seed yield (Kg ha⁻¹) and Stalk yield (Kg ha⁻¹) was observed in maize. Followed by T₈ - [NPK @ 60:30:20 Kg ha⁻¹ + FYM @ 62.5 t ha⁻¹ + Biochar @ 2.5 t ha⁻¹]. The economy of different treatment combination, The results showed that the application of NPK and FYM and Biochar in treatment T₈ - [NPK @ 60:30:20 Kg ha⁻¹ + FYM @ 62.5 t ha⁻¹ + Biochar @ 2.5 t ha⁻¹] provides highest net profit of Rs. 786,058.97 with cost benefit ratio 1:2.70. Followed by T₉ - [NPK @ 120:60:40 Kg ha⁻¹ + FYM @ 125 t ha⁻¹ + Biochar @ 5 t ha⁻¹] provides net profit of Rs. 784,640.83 with cost benefit ratio 1:2.2.

EVALUATING THE SIGNIFICANCE OF INTENSE HEAT FOR THE WHEAT CROP IN HARYANA

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Abstract

The country's wheat-growing area runs along the Indo-Gangetic Plains (IGP; 21°35'-32°28'N and 73°50'-89°49'E) and includes the states of Punjab, Haryana, and Uttar Pradesh. Wheat agriculture in India has become increasingly vulnerable in recent years, owing to high temperatures caused by climate change and fluctuation. This study broadens its scope by undertaking a comparative examination of heat wave trends in Haryana from 1981 to 2020. The study intends to identify trends and fluctuations in the frequency, severity, and duration of heat waves over the last four decades by reviewing historical meteorological data. This historical study is critical for explaining the current impact of high-temperature occurrences on wheat reproduction, and it provides significant insights into how climatic circumstances are changing. We assess the danger of wheat output dropping below its long-term average in this study by taking into account heat wave occurrences, the frequency and spatial extent of heat stress events, and their interactions in the region. To investigate the association between yield and climatic characteristics, we employed growth degree days (GDD), extreme degree days (EDD), and total rainfall throughout the crop growing season. Understanding the temporal development of heatwaves is critical for forecasting future trends and potential issues for wheat farming. Haryana's three districts with the most heatwave days in the previous four decades are Jind (800 days), Kurukhsetra (771 days), and Faridabad (767 days). Temperature extremes have a greater relationship with yield anomalies than precipitation extremes, and irrigation helps to buffer the detrimental consequences of high temperatures. Changes in India's wheat production have an impact on trade and food security both domestically and internationally. Accurate assessments of the national changes in wheat yield are therefore crucial.

EFFECT OF INORGANIC FERTILIZER, ORGANIC MANURES AND RHIZOBIUM INOCULATION ON SOIL PROPERTIES, GROWTH AND YIELD OF CLUSTER BEAN

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Abstract

A field experiment was conducted at the Research farm of Department of Soil Science, Naini Agricultural Institute at Sam Higginbottom University of Agriculture Technology and Sciences (SHUATS), Prayagraj (U.P.) during *Kharif* season of 2023-24. The field experiment was laid out in randomized block design (factorial) by replicating thrice consisting 18 treatments combinations of N:P:K, Poultry manure and Rhizobium Inoculation. Minimum bulk density (1.256 Mg/m³) and maximum pore space (49.73%), water holding capacity (41.80), organic carbon (0.386%), available nitrogen (284.93 kg/ha), phosphorus (22.14 kg/ha) and potassium (206.22 kg/ha) recorded with 100 % NPK which was statistically comparable with application of 50 % NPK. The Maximum B:C ratio (2.27) was recorded with this treatment. Minimum bulk density (1.254



Mg/m³) and maximum pore space (49.57%), water holding capacity (40.06), organic carbon (0.379%), available nitrogen (281.93 kg/ha), phosphorus (22.80 kg/ha) and potassium (201.88 kg/ha) recorded with 100 % (PM) poultry manure which was statistically comparable with application of 50 % PM. The application of 100 % Rhizobium inoculation recorded the best results in terms of growth parameters. The Maximum B:C ratio (2.29) was recorded with this treatment. Minimum bulk density (1.254 Mg/m³) and maximum pore space (49.50%), water holding capacity (38.80), organic carbon (0.363%), available nitrogen (276.38 kg/ha), phosphorus (20.15 kg/ha) and potassium (195.65 kg/ha) recorded with 100 % Rh. From the above data, it has been revealed that application of 100 % NPK + 100 % PM with 100 % Rh was beneficial for more production of cluster bean.

EFFICACY OF CERTAIN CHEMICAL AND BOTANICALS AGAINST DIAMONDBACK MOTH (*PLUTELLA XYLOSTELLA*) ON CABBAGE UNDER FIELD CONDITION

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Abstract

The Central Research Farm (CRF) is where the current investigation was carried out, Department of Entomology, SHUATS, Prayagraj during *Rabi* season 2021-22. In the Randomised Block Design, there were eight treatments, including an untreated control, and each was replicated three times. Eight treatments viz, Cypermethrin 25% EC, Spinosad @ 45% SC, Neem oil @ 2%, Karanj oil @ 2%, Chlorantraniliprole 18.5% SC, Datura leaf extract @ 5%, Fipronil 5% SC, one untreated plot was taken. The observation on overall larval population of *P. xylostella* on cabbage. This demonstrates that each treatment was vastly superior to the control. Chlorantraniliprole 18.5% SC (01.42) found superior followed by Spinosad 45% SC (01.65), Cypermethrin 25% EC (02.02), Fipronil 5% SC (02.17), Neem oil @ 2% (02.36), Karanj oil @ 2% (02.60), Datura leaf extract @ 5% (02.81) as compared to control (03.83). The results were quite interesting. This shows that each treatment was significantly better than the control. Chlorantraniliprole 18.5% SC (270.80 q/ha) (1:6.19), followed by Spinosad 45 SC (238.15 q/ha) (1:5.51), Cypermethrin 25% EC (220 q/ha) (1:5.46), Fipronil 5% SC (205 q/ha) (1:5.10), Neem oil @ 5% (170 q/ha) (1:4.0), Karanj oil @ 5% (165 q/ha) (1:4.0), Datura leaf extract @2% (135 q/ha) (1:3.40) vs the control (115 q/ha) (1:2.62).

EVALUATION OF ORGANIC COMPOSTS ON ROOT KNOT NEMATODE (*MELOIDOGYNE INCOGNITA*). OF OKRA (*ABELMOSCHUS ESCULENTUS* L.)

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Abstract

Okra [*Abelmoschus esculentus* L., Moench] a native of South Africa and commonly known as 'Bhindi' is an annual malvaceous vegetable crop, especially grown in tropical and subtropical climates. It is also called a "perfect villager vegetable". Root-knot nematodes are considered among the top five major plant pathogens and the first among the ten most important genera of plant parasitic nematodes in the world. Amongst nematodes, root-knot nematode (*Meloidogyne incognita* and *Meloidogyne javanica*) causes severe damage to okra. Spent mushroom compost, Vermicompost and Neem cake were tested under field conditions during *Kharif* 2021 for their efficacy against the Root knot nematode and growth & nematode population. Among the treatments the maximum plant height (cm) at 90 DAS was recorded in T6 - Vermicompost + spent mushroom compost + Neem cake + FYM (95.3) followed by T5 - Vermicompost + Neem cake + FYM (92.4) as compared to untreated check control T0 - (79.33 cm). The minimum Root weight was recorded in T6 - Vermicompost+ spent mushroom compost+ Neem cake + FYM (11.3 gm) followed by T5 - Vermicompost + Neem cake + FYM (11.46 gm) as compared to untreated check control T0 - Control + FYM (10.25gm). The maximum Root length was recorded in T6 Vermicompost+ spent mushroom compost+ Neem cake + FYM (20.36 gm) followed by T5 - Vermicompost+ Neem cake + FYM (17.01 gm) as compared to untreated check control T0 Control + FYM (10.46). The minimum nematode intensity (%) at 90 DAS was recorded in T6 - Vermicompost+ spent mushroom compost + Neem cake + FYM (56), followed by T5 - Vermicompost + Neem Cake + FYM (77) as compared to untreated check control T0 - (121).



PRINCIPLE OF INTEGRATED PEST MANAGEMENT

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Abstract

A comprehensive strategy for dealing with pests that have an adverse effect on the health of people and the environment as well as the economy is integrated pest management, or Integrated Pest Management. The pests most frequently linked to Integrated Pest Management are weeds, insects, and disease-causing pathogens. Simpler cropping systems, higher yields, and the avoidance of more intricate crop protection techniques were all made possible by the use of pesticides. However, an over-reliance on chemical control is linked to unfavorable health impacts and ecosystem contamination. The development of pest resistance and the dwindling supply of active ingredients are now additional threats to agricultural production's future. Therefore, farming systems that rely less on artificial pesticides must be designed. As a result, the European Union mandates that the eight integrated pest control principles that align with sustainable farm management be applied. Here, we offer farmers, advisors, and researchers a dynamic and adaptable strategy that can increase cropping systems' resilience and our ability to modify crop protection to local realities while taking into consideration the variety of farming scenarios and the complexity of agroecosystems. We propose that the key to prevention for each principle is the construction of naturally resistant cropping systems using a mix of agronomic levers. It is a reality to deal with the availability of monitoring, warning, and forecasting systems locally. Cropping system variables can be incorporated into the decision-making process to create longer-term plans.

BIORATIONAL MANAGEMENT OF MAJOR SUCKING INSECT PEST IN COWPEA, *VIGNA ANGUICULATA* WALP.

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Abstract

The aphid, *Aphis craccivora* Koch, leafhopper, *Empoasca fabae* (Harris) and whitefly, *Bemisia tabaci* (Genn.) are the serious sucking insect pest of this crop and occurs in different parts of India that causes 20-40 per cent yield losses. An experiment was carried out for the management of these three sucking insect pests in cowpea using different biorational insecticides. On the basis of per cent reduction of pest population in cowpea, spiromesifen 22.9 SC proved most effective against aphid, leafhopper and whitefly followed by dimethoate 30 EC against aphid, leafhopper and whitefly. The treatments, emamectin benzoate 5 SG, pyriproxyfen 10.8 EC, chlorfenapyr 10 SC and spinosad 45 SC were moderately effective; whereas, the treatment of *Beauveria bassiana* 1.15 WP, *Metarhizium anisopliae* 1.15 WP, azadirachtin 0.03 EC and NSKE (5.0%) were least effective against aphid, leafhopper and whitefly. The maximum seed yield of 21.32 q/ hectare was obtained in the plots treated with spiromesifen 22.9 SC followed by dimethoate 30 EC (19.56 q/ha) and minimum was obtained in *B. bassiana* 1.15 WP (11.09 q/ ha) and *M. anisopliae* 1.15 WP (11.27 q/ ha) treated plots.

IN-VITRO PROPAGATION STUDIES IN TURMERIC (*CURCUMA LONGA* L.)

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Abstract

The present investigation entitled “In-vitro studies in turmeric (*Curcuma longa* L.)” was conducted at Centre of Excellence in Plant Biotechnology, Biotechnology Centre, Department of Agricultural Botany, Post Graduate Institute (PGI), Dr. PDKV,



Akola during 2020-2021 and 2021-2022. The basic objectives were to assess effect of size of the explant for multiple shooting and rooting in turmeric and to standardize *in vitro* and *ex vivo* parameters for root maximization in turmeric variety PDKV Waigaon recently released for high curcumin content. During this study it has found that the explant size 3.00 cm when cultured on nutrient media containing MS + BAP 2.0 mg/L + NAA 0.5 mg/L was best among all the treatments shows highest number of culture survival 27.00 shoots with 90.00%. Among different surface sterilization treatment containing bavistin 0.1% + HgCl₂ 0.1% for 6 min showed highest explant survival 90.00%. Among the different nutrient media combination tried for shoot proliferation in treatment MS+BAP4mg/l+NAA0.5mg/L with 1.90, MS + BAP 4 mg/L + NAA 0.5 mg/L with 2.23, MS + BAP 2 mg/L + NAA 0.5 mg/L with 1.77 showed highest number of shoots. Similarly minimum number of days required for shoot initiation is taken by treatment MS + BAP 2 mg/L + NAA 0.5 mg/L with 8.87 days, treatment MS + BAP 2 mg/L + NAA 0.5 mg/L is 8.57 days, treatment MS + BAP 1 mg/L + NAA 0.5 mg/L with 9.50 days showed in Waigaon variety respectively. The survival percentage of total rhizome explants inoculated and responded well after every week interval at 25 ± 2⁰ C temperature, 16 hrs light, and 8hrs dark was recorded. After 4th week from the date of inoculation. The treatment MS + BAP 2 mg/L + NAA 0.5 mg/L with 90.46%, treatment MS + BAP 4 mg/L + NAA 0.5mg/L with 87.78%, MS + BAP 4 mg/L + NAA 0.5 mg/L with 82.22% showed highest shoot survival percentage. Different treatments of growth regulators showed different results, while shoot growth was always seen more after doing subculture. Some of the promising combinations of growth regulators BAP and NAA at different concentrations have been subjected. The maximum number of roots were found in treatment MS + NAA 1 mg/L with 13.80, treatment MS + NAA 1 mg/L, MS + NAA 1 mg/L with 14.27 followed by MS + NAA 0.5 mg/L with 14.10 while treatment MS + NAA 0.5 mg/L with 15.13 days, treatment MS + NAA 1 mg/L with 14.83, treatment MS + NAA 1 mg/L with 15.30days respectively. In order to acclimatize *in vitro* produced plantlets to natural environment, uniformly rooted plantlets were transferred in poly-tray containing cocopeat. The maximum number of roots (14.43) was found in treatment FMS + BAP 1.0 mg/L + NAA 1.0 mg/L with minimum of 14.37 days were required for rooting in FMS + BAP 1.0 mg/L + NAA 1.0 mg/L. While root induction and new root formation were studied by transferring the *in vitro* grown turmeric tissue culture plantlets to outside (*ex-vivo*). It was observed that during the *ex vivo* rhizogenesis i.e. hardening by using hardening media Sand + Soil + Peat (1:1:1 v/v) using portrays and polybags after 3 week of subculture and subsequent transplantation in green house. This variety recorded desirable attributes for micropropagation such as maximum number of shoots (2.23), minimum number of days required for shoot initiation (8.57days), highest survival % after 4th Week (87.78), highest number of shoots after subculture (5.60), maximum number of roots (15.17) lowest days for rooting (14.83days), and highest acclimatization (80%) as compared to other.

VARIATIONS IN WOOD SPECIFIC GRAVITY AND VOLUMETRIC SHRINKAGE OF FOUR TIMBER SPECIES

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Abstract

Wood is one of the most widely used renewable resources. It is highly variable in its texture, appearance and utility. In the past, only few well-known timbers like sal, teak, chir, sissoo, rosewood, semul, and padauk were used for various purposes. Increasing demand surpassed the supply of many popular species and the search for more timber species resulted in the exploitation of many exotic species like poplars, eucalyptus, acacias, etc. Local demand of the timber largely depends on the availability of the species. A preliminary survey of the data on the wood converted in the saw mills and bought by customers of Bhubaneswar indicated that *Shorea robusta*, *Tectona grandis*, *Acacia odoratissima* and *Acacia auriculiformis* are the most sought after species even though the volume of timber sold from each sawmill varied. The present study examined the variation in specific gravity and dimensional shrinkage in these species. The methodology followed for estimation of specific gravity, moisture content and volumetric shrinkage was the one specified in the Indian Standards 1708 part 2 (1986). All the samples (5 cm X 5cm X 15 cm in dimension) were exposed to the same set drying conditions for determination of specific gravity at various moisture levels. The results of the study indicated that the volumetric shrinkage in the four species varied from 1.31 to 4.76% of the original volume of the wood. The volumetric shrinkage of *Acacia auriculiformis* was found to be the highest followed by *Shorea robusta*, *Acacia odoratissima* and *Tectona grandis*. However, *Shorea robusta* exhibited seasoning defects indicating its refractory nature. Teak having the lowest volumetric shrinkage indicated that timber was moderately refractory was possessed moderate specific gravity. The specific gravity was determined to be 0.871 for *Shorea robusta*, 0.734 for *Tectona grandis*, 0.700 for *Acacia auriculiformis* and 0.660 for *Acacia odoratissima*. It was also observed



that all the species showed considerable increase in specific gravity with decrease in moisture content. The maximum moisture content varied from 72.5% to 113.47%. The maximum moisture content capacity was found maximum in *Acacia odoratissima*, *Acacia auriculi formis*(100.82), *Tectona grandis*(99.4) and *Shorea robusta*.

EVALUATING THE EFFICACY OF PITUITARY GLAND EXTRACTS AND OVAPRIM ON HAEMATOLOGY IN CYPRINUS CARPIO

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Abstract

The purpose of the present study was to know the effect of ovaprim and pituitary gland extract hormone injection in summer season (March to June) by analysis of some parameters such as RBC, WBC, Hb, PCV, MCV, MCH, MCHC and blood glucose of the experimental fish and compared in relation to sex and pre and post spawning after hormonal injection. The brooders (male & female) were treated separately with PGE and ovaprim. The results show higher value of RBC, Hb, PCV, MCH, and MCHC in male before hormonal injection. After treatment RBC, PCV, Hb, MCV, MCH, MCHC were decreased, while glucose increased. The male & female brooders treated with ovaprim have higher value of WBC and glucose compare to PGE.

Our Conference Memory



About the Chief Editor



Chief Editor

Dr. S.P. Singh, born in Village Jevri, Post Rajbun, District Meerut (U.P.), in 1970 and Graduated in Agriculture with Honors from G.M.V., Rampur Maniharan, Saharanpur (U.P.). He did his Post Graduation in Agricultural Botany, Institute of Advance Studies, Meerut University Campus, Meerut and Doctorate in the same discipline (Ag. Bot.) from C.S.J.M. University, Kanpur. Presently, he is working as Scientist (Plant Breeding) at C.S.A. University of Agriculture and Technology, Zonal Agriculture Research Station, Kalai, Aligarh (U.P.). Dr. Singh is a fellow of SRDA, and member of many other professional Societies, having **25** years of experience in Research and Extension Education Works. **He authored many books** such as Plant Breeding, Agriculture at a Glance, Hand Book of Agricultural Sciences (Hindi & English), Crop Physiology (Hindi & English), College Botany, Environmental Science & Agroecology, Concepts of Ecology etc. He is well recognized Scientist and having more than **300** publications in reputed National and International Journals. Dr. S.P. Singh is also **Editor-in-Chief, Progressive Research-An International Journal & Frontiers in Crop Improvement Journal** (both Journals are NAAS recognized), **Secretary**, Society for Scientific Development in Agriculture & Technology and also **President**, Astha Foundation, Meerut, working in the field of Science & Education.

He has been awarded as Best Editor and Writer Award-2006, Young Scientist Award-2007, Dr. M.S. Swaminathan Young Scientist Award-2009, Distinguished Scientist Award-2014, Scientific Initiator Award-2014 from Directorate of Rice Research, Hyderabad, Science Leader Award-2015 From RVSKVV, Gwalior, Outstanding Scientist in Agriculture Award-2016, Outstanding Achievement Award-2016, Excellence in Research Award-2017, Innovative Scientist of the Year Award-2017 Outstanding Scientist in Agriculture Award-2018 Before this International conference, Dr. S.P. Singh has already organized five conference at different corner of country, first conference was National symposium on “**Achieving Millennium Development Goal : Problems & Prospects**” at Bundelkhand University, Jhansi (UP) during October 25-26, **2009** under the umbrella of SSDAT, Meerut, Dr. Singh has been acted as an Organizing Secretary. The second was National conference on Emerging Problems and Recent Advances in Applied Sciences : Basic to molecular Approaches (**EPRAAS-2014**) during February 08-09, 2014 at Ch. Charan Singh University, Meerut (UP) again by SSDAT, Meerut in which Dr. S.P. Singh has played his role as an Organizing Chairman. The Third, Conference was Organized by SSDAT, Meerut and Astha Foundation, Meerut at Directorate of Rice Research, Hyderabad on Emerging Challenges and opportunities in Biotic and Abiotic Stress Management (**ECOBASM-2014**) during December 13-14, **2014**. Fourth Conference organized by Astha Foundation, Meerut & SSDAT, Meerut at RVSKVV, Gwalior on Global Research Initiatives for Sustainable Agriculture & Allied Sciences (**GRISAAS-2015**). Fifth Conference was jointly organized by SSDAT, Meerut & Astha Foundation, Meerut at PJTSAU, Rajendranagar, Hyderabad, Telangana State on Innovative and Current Advances in Agriculture & Allied Sciences (**ICAAAS-2016**) during December 10-11, 2016. Sixth Conference organized by Astha Foundation, Meerut in collaboration with SSDAT, Meerut, MPUAT, Udaipur; CSAUT, Kanpur; UAS, Raichur at MPUAT, Udaipur, Rajasthan on Global Research Initiatives for Sustainable Agriculture & Allied Sciences (**GRISAAS-2017**). Seventh Conference organized by Astha Foundation, Meerut in collaboration with SSDAT, Meerut, CSAUT, Kanpur; IGKV, Raipur; BAU, Sabour; MPKV, Rahuri; RARI, Durgapura, Jaipur; Global Research Initiatives for Sustainable Agriculture & Allied Sciences (**GRISAAS-2018**). Eight Conference organized by Astha Foundation, Meerut in collaboration with SSDAT, Meerut, CSAUT, Kanpur; IGKV, Raipur; BAU, Sabour; MPKV, Rahuri; UAHS, Shivamogga, Global Research Initiatives for Sustainable Agriculture & Allied Sciences (**GRISAAS-2019**). Ninth Conference organized by SSDAT, Meerut in collaboration with Astha Foundation, Meerut, Innovative and Current Advances in Agriculture & Allied Sciences (**ICAAAS-2020**) at Bangkok, Thailand. Tenth International Web Conference organized by Astha Foundation, Meerut in collaboration with SSDAT, Meerut, CSAUT, Kanpur; IGKV, Raipur; BAU, Sabour; MPKV, Rahuri; BAU Rachi and UAHS, Shivamogga on Global Research Initiatives for Sustainable Agriculture & Allied Sciences (**GRISAAS-2020**). Eleventh International Web Conference organized by SSDAT, Meerut in collaboration with Astha Foundation, Meerut, CSAUT, Kanpur; IGKV, Raipur; MPKV, Rahuri; BAU Rachi and UAHS, Shivamogga on Innovative and Current Advances in Agriculture & Allied Sciences (**ICAAAS-2021**).

Glimpse of SSDAT & Astha Foundation's Conferences



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